ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

IN THIS ISSUE

FACTORS AFFECTING SEWER-FLOW DIVERSION

AN EARTHQUAKE-PROOF STEAM PLANT DESIGN

OYSTER SHELLS PAVE RESIDENTIAL STREETS

Triple-tank surge structure towers over Ft. Peck powerhouse

MORE BIG INDUSTRIAL INSTALLATIONS

4

FOR RADIANT HEATING WITH BYERS WROUGHT IRON PIPE

The Chase Bag Company recently celebrated its 100th anniversary by completing three new factories and a factory addition. All of these modern structures have radiant heating, and more than 25 miles of Byers Wrought Iron pipe, in sizes from 1¼ to 5-inch, were used in the various installations for the heating coils and for auxiliary lines.

MAXIMUM EFFICIENCY—MAXIMUM COMFORT

The illustrations show typical design and procedure. Pipes were welded into grids for manufacturing, warehouse and garage areas, formed in sinuous coils for second floor areas. Hot water is used for heating. The building was divided into zones with individual circulators used for each. Shortly after one building was completed, outside temperatures dipped to 15° below. Comfort conditions within the plant were reported as "excellent."

UNIQUE PROPERTIES

The almost universal use of wrought iron pipe for radiant heating results from engineer recognition of its unusual advantages. It is easily formed and welded. It has high heat emission. It expands and contracts at practically identical rates with concrete, avoiding the danger of thermal cracks, and loss of bond. Finally, its superior corrosion resistance has been conclusively demonstrated.

HELPFUL LITERATURE

Our bulletin, "Byers Wrought Iron for Radiant Heating", gives complete technical information on calculation, design, and layout. Ask for a copy.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

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March 18, 1948

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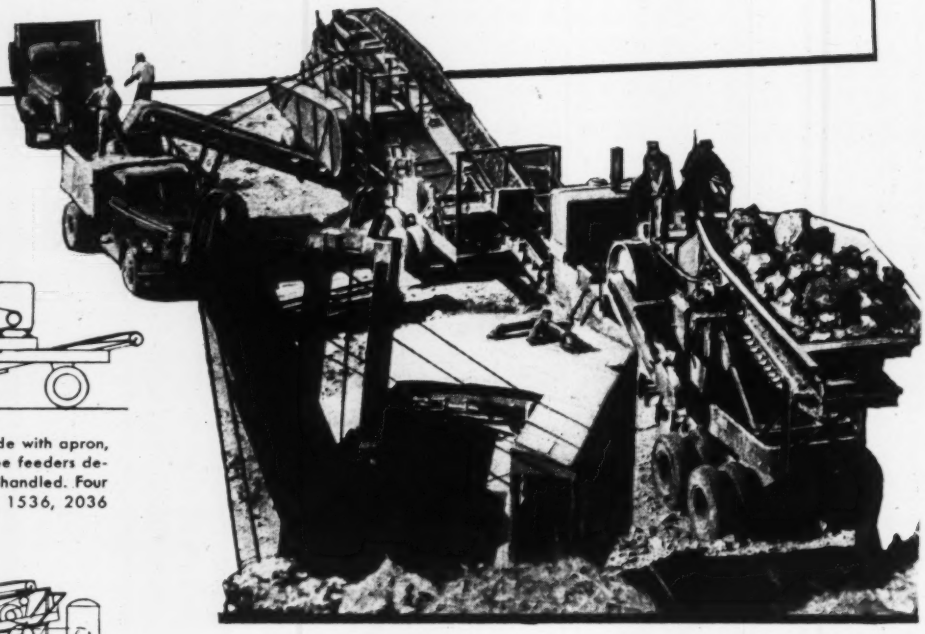
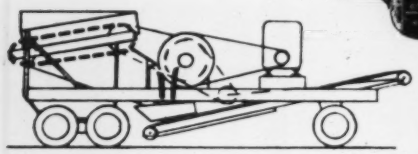
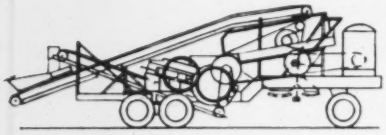
CRACK-MOVING COSTS! CRUSH-MORE MATERIAL!

Pioneer *Continuflo* 2-UNIT PLANTS

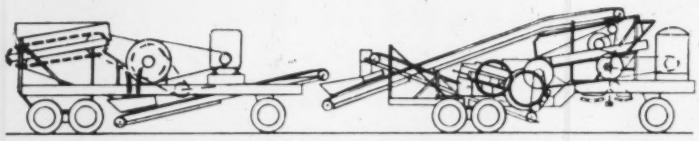




1. PRIMARY PLANTS. Made with apron, traveling grizzly or gravel-type feeders depending upon material to be handled. Four sizes of jaw crushers—1036, 1536, 2036 or 2436.



2. SECONDARY PLANTS. Unique split feed doubles the effective screening area of the 3½ deck vibrating screen. Two sizes of roll crushers available—4022 or 5424.



3. FLEXIBLE. Primary and secondary plants operate independently or as a matched and balanced engineered unit. Bigger crushers, larger screens are built into easily moved plants. *Result*—higher capacities of rock and gravel are now available from portable plants.

Have you ever stopped to figure how much it really costs to move an ordinary rock or gravel plant from one job to the next? When you include your salary, the wages of your crew, gasoline and lost production, you'll conclude that every hour wasted is a mighty expensive luxury.

To lick this problem, PIONEER has developed a complete line of 2-Unit Rock and Gravel Plants. They cut moving costs, meet stringent weight restrictions and *really produce on the job*. PIONEER's new catalog on 2-Unit Plants gives all the facts. Write for it today!

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BUY BOTH!

Higher Output, Lower Upkeep!

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Continuflo EQUIPMENT

Construction Trends

Private Investment Financing in 1947 Largest Since 1930

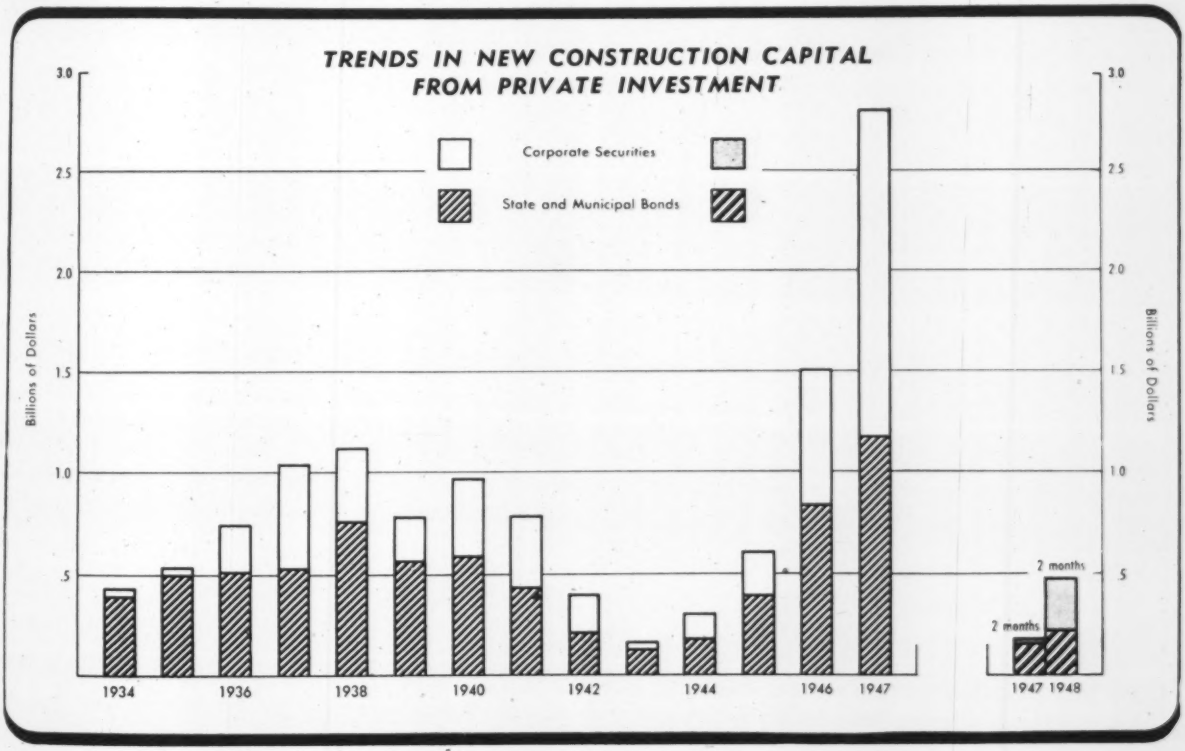
New construction capital available from private sources in 1947, amounting to $2,819,346,000, was 87 percent greater than the $1,509,699,000 made available in 1946. Of the total new capital in 1947, 58 percent went into corporate securities and the remaining 42 percent into state and municipal bonds. This was a reversal of the 1946 ratios which showed an investment of 44 percent in corporate securities and 56 percent in state and municipal bonds.

Corporate securities, totaling $1,641,428,000 in 1947, were nearly two and a half times the 1946 total of $661,558,000. The 1947 volume was the largest recorded since 1930, when approximately $2,000,000,000 of new money was made available for construction. Of the 1947 total, however, $1,208,742,000 was borrowed or raised by public utilities for the purpose of expanding facilities supplying gas, electricity, water and telephone service. Approximately half of this total was raised by the American Telephone and Telegraph Co. in 1947. The company and its subsidiaries are engaged in large construction programs which require the obtaining of substantial amounts of new capital.

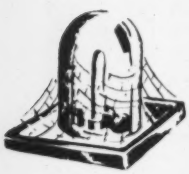
Construction capital invested in state and municipal bonds rose to $1,177,918,000 in 1947, a gain of 39 percent over the 1946 volume of $848,141,000. This was the highest volume recorded since 1930, when approximately $1,500,000,000 were invested in state and municipal bonds. Of the 1947 total, 42 percent has been slated for buildings, or $498,699,000. The remaining 58 percent has been earmarked for waterworks projects, sewerage projects, streets and roads, airports and other construction.

Private capital for new construction in the first two months of 1948 totaled $496,862,000 compared with $183,005,000 recorded for the corresponding period of 1947, a gain of 172 percent. Corporate securities amounted to $272,992,000 during this period compared with $17,845,000 in 1947, and state and municipal bonds to $223,870,000 compared with $165,160,000 in 1947.

Corporate securities were at an unusually low level during the first two months of 1947. The substantial expansion which took place during the year did not begin until the second quarter of 1947. The weekly average for the first quarter of 1947 amounted to $2,247,000 compared with the second quarter average of $23,734,000, the third quarter average of $20,624,000 and the fourth quarter average of $79,657,000.



"Off Again, On Again, Goin' Again" Finnegan

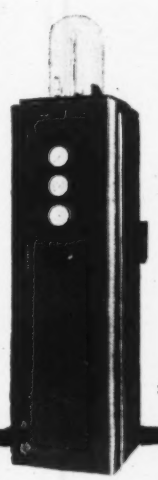


Mr. Finnegan's "short and sweet" wire to his section boss may aptly be applied to a W&T Visible Vacuum Chlorinator in intermittent service. The W&T Visible Vacuum Chlorinator can be turned on or off for long or short periods—yet, with but ordinary care, it will be "on the track" and ready to go at *all* times.

No "warm-up" time is necessary and there are no delicate parts to get out of order or become "frozen" during inactive periods—just turn it on when needed and watch this chlorinator "highball" along.

So for tough seasonal service—the hardest kind of chlorinator duty—as well as dependable continuous operation choose the visible vacuum principle backed by W&T's thirty-five years' experience.

Your W&T Representative can put you on the right track in selecting the right type for each particular job—ask him or write for the information you require.



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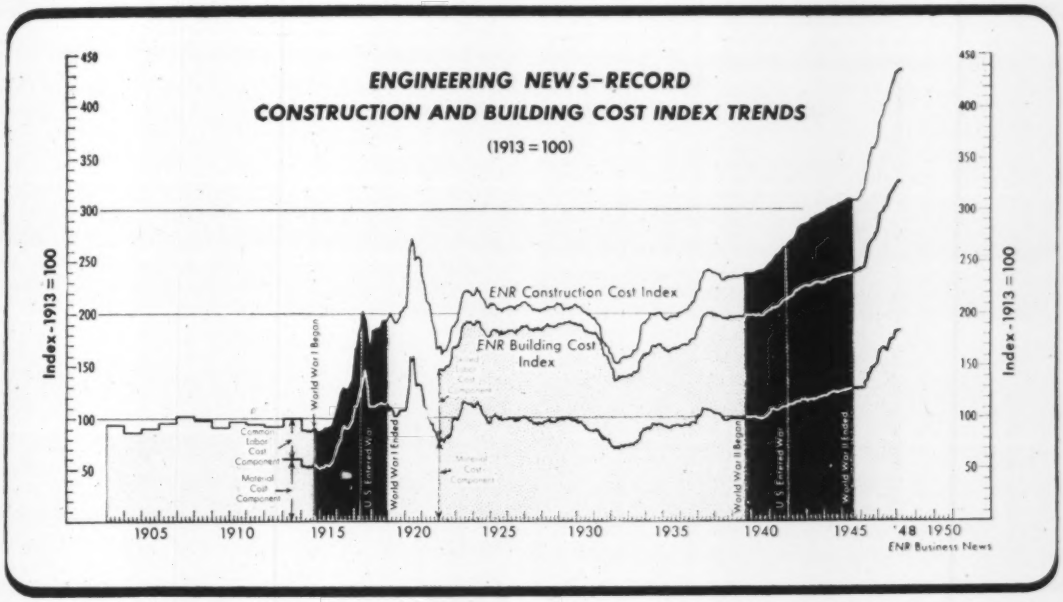
S-25

MARCH CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	February 1947 (4 wk.)	February 1948 (4 wk.)	% Change	Two Months 1947 (9 wk.)	Two Months 1948 (9 wk.)	% Change
Total U. S. Construction	$356,491	$474,643	+33	$787,461	$916,508	+16
Private Construction	228,567	227,010	−1	508,482	434,539	−15
Public Construction	127,924	247,633	+94	278,979	482,059	+73
Federal	28,757	134,248	+367	71,945	190,415	+165
E N R Construction Volume Index, 1913 = 100	197	234	+19	196	205	+5
Total New Productive Capital	$74,592	$271,012	+263	$183,005	$490,862	+172
Private Investment	74,592	271,012	+263	183,005	490,862	+172
Federal (non-federal work)	.....	.....	.....	.....	.....	.....
Federal (federal work)	.....	.....	.....	.....	.....	.....

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Mar., 1948	438.41	210.74	329.03	177.86	.....	.....
Feb., 1948	436.89	210.01	329.71	178.23	234	103
Jan., 1948	434.99	209.10	326.92	176.72	175	77
Dec., 1947	432.30	207.81	325.27	175.83	251	110
Nov., 1947	429.30	206.36	322.27	174.21	238	104
Oct., 1947	424.41	204.01	320.58	173.30	234	103
Sept., 1947	417.81	200.84	317.08	171.40	255	112
Aug., 1947	415.00	199.49	313.03	169.21	215	94
July, 1947	406.52	195.41	304.87	164.80	222	97
June, 1947	403.29	193.86	303.14	163.87	276	121
May, 1947	396.49	190.59	299.61	161.96	224	98
Apr., 1947	396.09	190.40	300.81	162.61	247	108
Mar., 1947	391.95	188.41	298.84	161.54	220	96
Feb., 1947	390.76	187.84	297.65	160.90	197	86
1947 (Av.)	407.13	195.71	307.68	166.32	231	101
1946 (Av.)	345.94	166.29	262.25	141.76	248	109
1945 (Av.)	307.75	147.93	239.14	126.27	123	54
1944 (Av.)	298.72	143.59	234.73	126.86	96	42

CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICES

1913 = 100	March 1947	March 1948	% Change	Change February to March 1947 Feb.	1947 Mar.	%	Change February to March 1948 Feb.	1948 Mar.	%
E N R Constr. Cost Index†	391.95	438.41	+11.85	390.76	391.95	+0.30	436.89	438.41	+0.35
E N R Building Cost Index†	298.84	329.03	+10.10	297.65	298.84	+0.40	329.71	329.03	−0.21

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

	March 1947	March 1948	% Change	Change February to March 1947 Feb.	1947 Mar.	%	Change February to March 1948 Feb.	1948 Mar.	%
Common Labor	$1.118	$1.283	+14.76	$1.118	$1.118	0.0	$1.272	$1.283	+0.86
Skilled Labor (Av. 3 Trades)	1.922	2.153	+12.02	1.922	1.922	0.0	2.153	2.153	0.0
Bricklayers	2.056	2.303	+12.01	2.056	2.056	0.0	2.303	2.303	0.0
Structural Ironworkers	1.924	2.172	+12.89	1.924	1.924	0.0	2.172	2.172	0.0
Carpenters	1.787	1.986	+11.14	1.787	1.787	0.0	1.986	1.986	0.0
Cement, bulk, per barrel	2.48	2.80	+12.91	2.44	2.48	+1.64	2.79†	2.80	+0.36
Structural Steel, base	2.50	2.80	+12.00	2.50	2.50	0.0	2.80	2.80	0.0
Sand, per ton	1.761	1.915	+8.75	1.729	1.761	+1.85	1.897†	1.915	+0.95
Lumber, 2x4 Fir, per M ft.	82.795	99.32	+19.96	80.696	82.795	+2.60	99.74	99.32	−0.42
Lumber, 2x4 Pine, per M ft.	81.492	91.51	+12.29	81.598	81.492	−0.13	92.77	91.51	−1.36
Common brick, per M	22.80	25.325	+11.07	22.262	22.80	+2.42	24.738	25.325	+2.37
Ready-mixed concrete, c.y.	8.789	9.982	+13.57	8.673	8.789	+1.34	9.898†	9.982	+0.85
Struct. clay tile, 3x12x12	107.293	120.77	+12.56	107.293	107.293	0.0	119.17*	120.77	+1.34

† *Revision.* * *Correction.*

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	February 1947	February 1948	% Change	Jan. 1948	% Change Jan. to Feb.
Steel (% Operating Capacity) A.I.S.I., weekly average	93.7	93.2	−0.5	97.0	−3.9

	December 1946	December 1947	% Change	Twelve Months 1946	Twelve Months 1947	% Change
Cement, thous. bbl. U.S.B. of Mines	11,494	12,380	+7.7	169,336	187,396	+10.7

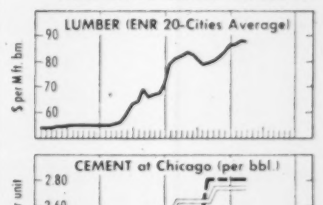
	January 1947	January 1948	% Change	Twelve Months 1946	Twelve Months 1947	% Change
Fabricated Structural Steel, tons, A.I.S.C.	140,650	130,871	−7.0	1,551,607	1,915,144	+23.4
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$156,531	$286,513	+83.0	$2,556,380	$3,086,202	+20.7

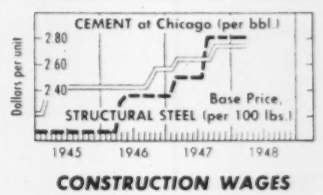
COST OF LIVING INDEX . . . . EMPLOYMENT

Base 1935-39 = 100	1941	January 1947	January 1948	% Change	December 1947	% Change Dec. to Jan.
Consumers' Price Index, B L S	105.2	153.3	168.8	+10.1	167.0	+1.1
Rent (Housing) Index, B L S	106.2	108.8	115.9	+6.5	115.4	+0.4

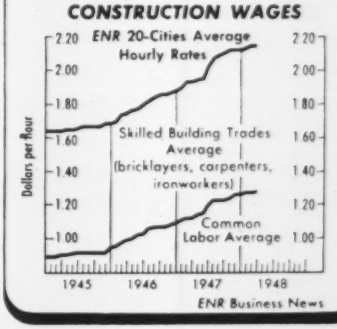
	January 1947	January 1948	% Change	December 1947	% Change Dec. to Jan.
Contract Constr. Employ. (est.), thous., B L S	1,527	1,645	+7.7	1,788	−8.0

MATERIAL COST PRICES



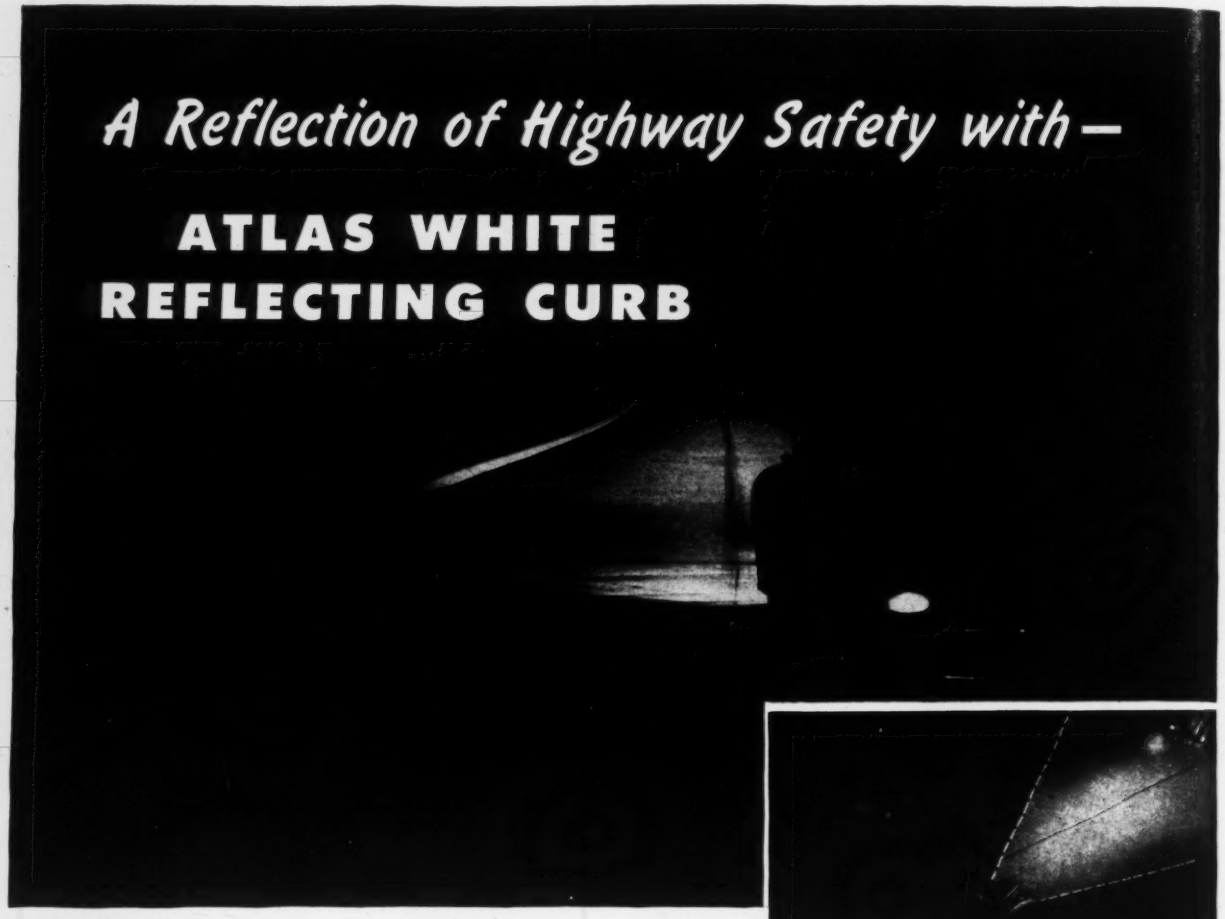


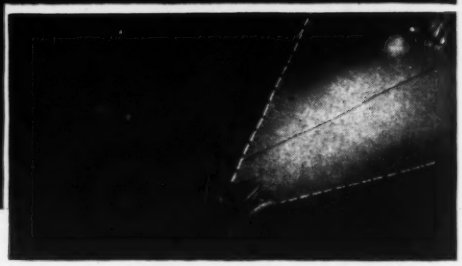
CONSTRUCTION WAGES



A Reflection of Highway Safety with—

ATLAS WHITE REFLECTING CURB



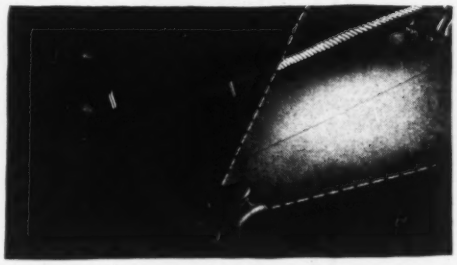


A smooth curb wastes the car's headlights. It reflects light away from the driver. Edge of road is difficult to see. Driving dangers are increased.

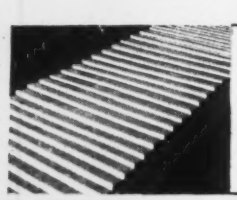
The driver of this car is fortunate. Driving along this highway is easier on his eyes and nerves. Chances of accident are reduced. Why? Because he can easily see the white guide that edges the highway . . . Atlas White Reflecting Curb made with Atlas White Cement. It gives him a clear outline of the road ahead.

Scientifically designed saw-tooth faces of white reflecting curb act like so many small mirrors when hit with beams from a car's headlights. They reflect the light back to the driver. This concentrated illumination greatly aids the driver's vision on a dry night... and on wet, rainy nights the reflecting curb becomes even more mirror-like and shows up even brighter.

Send for full details. Write to Atlas White Bureau, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.



White Concrete Reflecting Curb utilizes the car's headlights. Saw-tooth faces mirror the light back to driver; form a continuous, bright ribbon of light at the road's edge. Driving is safer.



ATLAS WHITE CEMENT

For White Concrete Reflecting Curb

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • MARCH 18, 1948 • VOLUME 140 • NUMBER 12

AFL unions approve pact to end jurisdictional strikes

Follow AGC, specialty contractor action in move to set up arbitration machinery—New York unions ratify wage agreement freezing wages at present rates

Final approval of a nation-wide agreement that may end jurisdictional strikes in the construction industry was voted last week by representatives of 19 major building trades unions.

The union action, following ratification of the pact by the Associated General Contractors at their recent annual convention at Dallas, Tex. (*ENR* Feb. 19, vol. p. 235) culminates more than a year of negotiation between the Building Trades Department of the American Federation of Labor, the AGC, and a group of five specialty contractor organizations, to provide machinery to end inter-union disputes.

In a parallel move, 39 of 42 construction unions in the metropolitan New York area voted approval of an agreement with the Building Trades Employers' Association that virtually freezes wages at their present levels (*ENR* Jan. 8, vol. p. 23).

The national agreement approved by the AFL groups at Washington, provides for the establishment of a national joint board, composed of an impartial chairman, two labor and two contractor members, and a pool of 24 members representing labor and employers to be available for arbitration proceedings. A board of trustees—also with joint labor-management membership—will receive notices of disputes, and determine if arbitration or other action is necessary or possible.

The decision of the national board would be binding on firms and unions signing the original agreement. Under terms of this agreement, work would continue during consideration of the dispute. Cost of operation of the plan would be borne jointly by the unions and contractors.

Effective date of the plan's operation will be fixed when the eight trustees appointed meet—probably within a month—to select an impartial chairman. Trustees are: For employers—James Marshall, assistant AGC managing director and Edward P. Palmer, of Senior and Palmer, New York; H. R. Cole, of the Tile and Mantle Contractors Assn., and P. M. Garry, of the Electrical Contractors Association; for labor—M. A. Hutcheson, carpenters; William O'Neill, plumbers; James Close, sheet-metal workers, and Richard Gray, head of the AFL Building and Construction Trades Department.

New York agreement

The New York unions, making their second try within a year for a pact to stabilize wages and prices in the metropolitan area, formally approved the January agreements. Union heads formally signed on March 15.

The new contract permits some wage rises to equalize the various trades, but in effect freezes most wages at their present levels until July 1, 1949. At that time, wages may be increased, but only if the cost of living as reported by the U. S. Bureau of Labor Statistics has shown a rise of more than 15 percent.

While major interests in the construction industry thus reported progress toward ending disputes, numerous settlements were reported.

At St. Louis, Mo., commercial lathers ended a two-month strike after receiving a 12½-cent general increase; journeymen plumbers at Binghamton, N. Y., accepted a raise to $2.15 per hour; carpenters at Pendleton, Ore., were increased 25 cents to $2 per hour; and in Chicago, Ill., six building trades unions with some 11,000 members, will be granted pay increases averaging 10 percent, starting in June.

At Rochester, N. Y., tile and marble masons ended a four-day walkout after accepting an arbitration award of 25 cents an hour in increased pay to bring their scale to $2.20 an hour.

The Atlanta, Ga., Construction Employers Council, meanwhile, asked public support of its resistance to demands for further labor wage increases that would bring journeymen painters to $2 an hour.

High court finds gypsum-board trust

Six national manufacturers of gypsum-board last week were held to have violated the Sherman Anti-trust Act, in a decision handed down by the U. S. Supreme Court.

The court held that the firms were guilty of violation by conspiring (through patents) to fix prices on patented gypsum board; standardize its production to eliminate competition, and to regulate the distribution of gypsum board by eliminating jobbers and fixing resale prices of manufacturing distributors.

Firms named are: National Gypsum Co., Certain-Teed Products Corp., Newark Plaster Co., Ebsary Gypsum Co., Celotex Corp., and the United States Gypsum Co.

Said the court: "Patents grant no privilege to their owners of organizing the use of those patents to monopolize an industry through price control, through royalities for the patents drawn from patent-free industry products, and through regulation of distribution—".

The court also pointed out that after 1929 the defendants ceased to manufacture open-edge (unpatented) board, and concurred in government claims that production of the unpatented board was discontinued in order to protect the patented board from competition.

"The provision in the license contracts that royalties should be paid on the production of unpatented board", the court said, "strongly indicates an agreement not to manufacture unpatented board, and the testimony of the witnesses is ample to show that there was an understanding, if not a formal agreement, that only patented board would be sold," the decision said.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction — Extensive improvements in the Pennsylvania Railroad's yards at *Columbus* and *Sandusky* will cost $1,300,000 . . . The Peoples Natural Gas Co., *Pittsburgh, Pa.*, plans to spend $13,000,000 for plant additions in 1948 and 1949 . . . Coahoma County, Miss., is planning to build a 125-bed, $1,000,000 hospital at *Clarksdale* . . . A $1,000,000 engineering building has been started for C. F. Brann & Co., *Alhambra, Calif.* . . . Construction will start near *York, Pa.*, on a new "Big Inch" pipeline paralleling the present "Big" and "Little" inch lines by the Texas Eastern Transmission Corp. This 26-in. pipe will run from southeast Texas to *Linden, N. J.*

Highways—It is reported that contractors' competition is increasing and costs decreasing in highway building in *Texas*. The road department, expecting bids March 30 on about $6,300,000 more projects said costs are now only 26 percent above 1940 . . . The province of *Saskatchewan* will spend $1,200,000 for roads and $200,000 for bridges in 1948 . . . On April 1 the gasoline tax in *Kentucky* becomes 7 cents a gallon . . . *Broome County, N. Y.*, has approved the proposed state-sponsored $20,600,000 arterial program for the *Binghamton area*, and the *Onondaga County, N. Y.*, supervisors have approved the arterial highway program in the *Syracuse* area . . . Damage to highways in *Arkansas* in January was so extensive that repair work will curtail most new construction. It is said that it will cost about $10,000,000 to put the roads back in shape . . . It will cost about $2,700,000 to repair winter damage to roads in *Rhode Island* . . . Highway and bridge construction contracts of $26,166,000 will be awarded by Massachusetts Highway Commission by June 30. Among the projects scheduled for construction this spring is an overhead expressway connecting Logan Airport, East Boston, with the end of Sumner Tunnel, $6,200,000.

Housing — An 18-story apartment hotel to cost $1,400,000 will be built at *Columbia, S. C.*, by Congress Const. Co. . . . Construction of 25 three-family houses to cost $500,000 has been recommended by the city council of *Minneapolis, Minn.* . . . The Home Builders Association of *Rhode Island* is opposing a proposed law that would require one-year $3,000 bonds from contractors to guarantee new houses against structural defects . . . The housing authority of *Boston, Mass.*, will receive bids April 9 for the $6,000,000 South End Cathedral housing project . . . Three new men's dormitories, to house 1,000 students are to be built at Louisiana State University at *Baton Rouge*.

Sewers—*Bremerton, Wash.*, has been allocated $600,000 by the state to aid construction of a $1,300,000 sewer system . . . *Baltimore, Md.*, is having plans drawn for a $1,000,000 sludge-drying plant . . . *Boise, Ida.*, has sold a $1,555,000 bond issue for a sewage disposal plant . . . *American Fork, Utah*, has been advised by consulting engineers that its proposed sewer will cost about $730,000 . . . *Coffeyville, Kan.*, has awarded a contract for construction of sewers in Edgewood . . . Plans for new sewers and sewage treatment works in five Indiana cities have been approved by the state stream pollution board. The cities are: *Bedford, West Lafayette, Logansport, Whiting* and *Westerville*.

Biggest Canadian Hotel *— The 23-story, $6,000,000 Laurentien Hotel, faced with gleaming aluminum, has been completed and is now open for service at Montreal, Canada. The fluted aluminum facings—some 200,000 lb. of the metal—were credited with greatly speeding construction. The structure also includes more than 1000 prefabricated bathroom units and other novel features. A complete technical article on this hotel will appear in a forthcoming issue of Engineering News-Record.*

States hard put to match federal aid

One of the gravest problems facing state highway officials today is the finding of sufficient funds to match federal appropriations for work on the highways, a group of engineers were told last week.

Meeting at Salt Lake City, Utah, for the Ninth Annual Highway Engineering Conference of the University of Utah, engineers representing 15 western states heard discussions that ranged from economics to soil compaction and road design.

J. S. Wright, Deputy Commissioner of the U. S. Bureau of Roads, told the group that the federal government has $700,000,000 to spend on highway construction during 1948-49. He said, however, that the "trouble with the program is that the states have a difficult time matching government grants."

R. E. Livingston, of the Colorado highway department, warned the engineers that a uniform code on load limits for trucks and to guide future highway construction is becoming a necessity. "Truck loads are getting heavier all the time, and it's either constructing heavier roads or putting a load limit on the trucks," Mr. Livingston said.

Other papers included: A discussion of the plant-mix road by F. N. Hveem, staff and materials engineer, California division of highways; R. W. James, Denver, urban engineer for the Public Roads Administration; Joseph E. Havenner, manager of the Public Safety Department of the Automobile Club of Southern California; W. C. Williams, assistant chief engineer, Oregon State Highway Commission, and Hal H. Hale, executive secretary of the American Association of State Highway Officials.

Mr. Hale conducted a meeting to make preliminary plans for the national group's annual convention, scheduled at Salt Lake City Sept. 19-24.

A. Diefendorf, head of the civil engineering department of the University of Utah, presided at the meetings.

Kentucky appoints new roads engineer

Dwight H. Bray of Frankfort last week became chief highway engineer for the Kentucky State Highway Commission, succeeding Thomas H. Cutler.

Mr. Cutler, chief highway engineer since 1936, became a consulting engineer on the department's technical staff.

Mr. Bray has been with the highway department since 1920, and headed the division of design for three years.

Urge speed in selecting urban work under federal-aid highway provisions

Mississippi Valley highway officials learn that the urban program is lagging—Discuss state-wide highway surveys

Facing the need for speed in designating projects for construction under the urban section of the federal-aid highway act, cities should immediately designate "interim systems"—such parts of the ultimately desirable system as may be recognized and designated without extended consideration—midwest highway officials were told last week.

Meeting at Chicago, delegates to the 39th annual meeting of the Mississippi Valley Conference of State Highway Departments heard reports from 15 member states indicated that commitments for federal-aid money were moving very slowly, and then turned to Public Roads Administration Officials for advice on selection and design of urban arteries. Other speakers at the three-day session discussed requirements for a state long-range planning survey, and discussed other phases of highway work.

O. L. Kipp, assistant commissioner and chief engineer, Minnesota Department of Highways, St. Paul, was elected president, succeeding R. C. Keeling, Kansas state highway engineer. C. E. Vogelgesang, chief engineer, Indiana State Highway Department, Indianapolis, was chosen secretary.

H. S. Fairbank, deputy commissioner, PRA, answered the fundamental questions regarding the basis for selection of a federal-aid urban system. He pointed out that such a system: (1) is restricted to the principal routes or arteries in an "urban area" (not necessarily a municipality); (2) may include present federal-aid routes or may relocate them to serve internal traffic better; (3) requires addition of area-tapping distribution branches from the main lines of the existing federal-aid system; (4) and should "contribute to the ultimate development of a complete system of urban arterial highways".

"The necessity of finding projects for immediately available funds," said Mr. Fairbank, "suggests the immediate designation of what are described as interim systems. . . . They consist of such parts of the ultimately desirable system as it is possible to recognize and designate without extended consideration. Upon interim systems so selected, immediately available funds can be properly expended."

In further explanation of present requirements, Mr. Fairbank and his PRA associates at the meeting said that it is not necessary to submit a complete interim system in order to obtain approval for projects on new federal-aid routes in an urban area. Such projects can be, and have been, approved, it was stated.

"Thus far," he said, "only 15 interim selections have reached our office for review, of which seven are from one state. The mileage of federal-aid routes within designated urban areas at present totals approximately 15,000, practically all composed of connections of the previously existing federal-aid system across the urban areas."

Discussing the design of arterial routes for urban areas, Joseph Barnett, chief, Urban Road Division, PRA, described the basic factors of the design problem. He recommended freehand reconnaissance sketches as a first step in testing several possible lines, aided by aerial maps when available.

State planning surveys

Noting the rapid spread of state surveys to determine highway needs and long-range programs, J. P. Buckley, Automotive Safety Foundation, Washington, D. C., told the conference that comprehensive studies similar to those made in California in 1946 and recently in Michigan (*ENR* Feb. 19, 1948, vol. p. 239) are actively under way in Kansas, Nebraska, Washington and Oregon and are planned for the immediate future by at least 20 other states. In describing the Michigan study, on which he served as engineer-director, Mr. Buckley emphasized the importance of having state legislatures, counties, municipalities and highway user groups participate in the studies with the state highway departments.

"The studies completed and nearly all those under way", he said, "were either sponsored by the state legislature or have a direct tie to the legislature. This is important. The legislature in the final analysis must take any report resulting from the survey, consider it and enact the necessary legislation to put the program into effect."

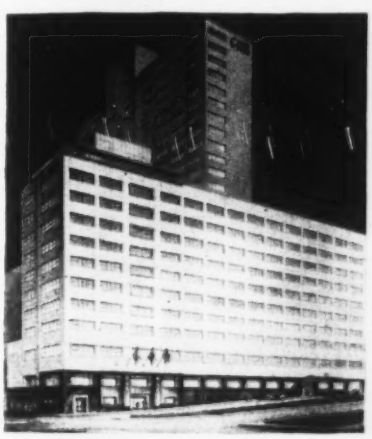
As a factor distinct from the engineering study itself, he pointed to the necessity for a public information service to lay the facts before the people, both during and after the study. "Specifically", he declared, "the people should be informed that highways cost money and if they want an adequate highway system they must pay the bill."

Bituminous resurfacing

Two speakers discussed bituminous resurfacing and widening of rural pavement. C. R. Hanes, field engineer, Ohio Department of Highways, describing practices in his state, declared that stepped-edge construction of flexible-base widening strips for bituminous resurfacing had proved preferable to the former method of using forms along the edge. Less displacement has been observed with stepped-edge construction at the joint between the widening and old pavement, he said. Ohio ordinarily employs multiple-course resurfacing, laid by machine. After finding 2 in. of bituminous concrete too light for the purpose, the department now uses 2½ in., on top of the wedge or leveling course. Mechanical equipment generally is employed by contractors in the state for cutting trenches, spreading materials and rolling.

As the economic basis for resurfacing old concrete pavement, W. R. Wooley, materials engineer, Division 4, PRA, offered a rough yard-stick, based on certain assumptions, that the time to resurface is when the annual amount of patching required is more than one percent of the total surface area.

Failures have been noted, Mr. Wooley said, in bituminous widening of concrete pavement on the inside of superelevated curves. Thicker bases or provision for drainage probably would correct base failures in plastic soils at such locations, he declared.



High for Aviation —An architect's sketch shows the proposed International Aviation Building to be built on the site of the central station at Dorchester St. of the Canadian National Railways in Montreal. The contract for the $10,000,000 structure was awarded recently to England Norcross Quebec, Ltd., of Montreal.

Industry men urge clearer wording of pollution control regulations

Effects of stream pollution on industrial development discussed at New Jersey Sewage Works meeting—Harry P. Croft honored—Leslie E. West elected president.

State regulations for stream-pollution control, which rely entirely on interpretation of technical terms, make it difficult for industrial management to evaluate what action is required for compliance. This is the opinion of W. B. Hart, superintendent of the gas, acid and drainage department, Atlantic Refining Co., Philadelphia, Pa., who spoke in a symposium dealing with the effects of stream pollution on economic development that featured a meeting of the New Jersey Sewage Works Association held in Trenton, N. J., last week.

Mr. Hart suggested that specifications be written in commonly-understood units of measurement that would have meaning for industrial managers and other non-technical personnel.

"Terms—such as biochemical oxygen demand and suspended solids—mean little or nothing to those who must approve expenditures for industrial-waste treatment", he said. "Industry must be asked to meet definite specifications that are standardized in so far as possible on a nation-wide basis."

Mr. Hart pointed up factors spurring the interest of industry in pollution abatement. "In the past, industry has depended largely on groundwater supplies, but, with serious diminution of these sources, it has been forced to turn its attention to use of surface water," he commented. "In addition, increasing approval of state appropriations for enforcement of water-protection regulations indicates that industry must assume responsibility for treating waters that enter streams."

Pollution-control enforcement does not cause industry to leave a state, said Mr. Hart, but may actually encourage construction of new plants. Citing Pennsylvania as an example, he reported that 22 manufacturers had located there despite intensification of pollution abatement.

The pulp and paper industry recognizes its responsibility for pollution abatement, stated Dr. Harry Gehm, technical advisor, National Council for Stream Improvement, Inc. As an outstanding example, he reported that one New Jersey mill recently completed a $250,000 installation for the recovery of liquor from flax pulping. This plant, built solely for the prevention of stream pollution, will provide full-scale operating data and experience on the treatment on weak liquors of this type.

The 33rd annual meeting of the New Jersey Sewage Works Association was dedicated to Harry P. Croft, who has completed his 30th year as chief engineer of the New Jersey State Department of Health.

The attitude of the Bell Telephone System in regard to pollution was expressed by John G. Segelken, special representative. He said: "Our company believe there should be no such thing as stream pollution. This is not a 'holier than thou' attitude. We have simply found it to be sound business policy."

Pollution-abatement work at the Manville, N. J. plant of the Johns-Manville Corp. was described by E. I. Merrill, plant engineer. He reported that activities were directed toward three objectives: Avoidance of stream pollution; conservation of water; and recovery of valuable materials. In addition to extensive treatment of wet wastes by sedimentation and filtration, air-borne wastes at the plant are settled out in a dust-collection system. From the operation 36 tons of waste per day are collected from which 29 tons are reclaimed for use. As an example of industry cooperation, Mr. Merrill told how alkaline wastes from the Manville plant are delivered to a downstream chemical company where they are used for neutralizing an acid discharge to the river.

Sewer rentals favored

In support of municipal sewer-rental ordinances, Chester W. Paulus, mayor, New Brunswick, N. J., declared that the user should pay his fair share for maintenance and operation of a sewerage system. Where such systems are financed from property taxes, unfair burdens are placed on those not served by sewer connections the official reported.

Sewer rentals, Mr. Paulus said, are determined on the basis of water consumed. In New Brunswick, the charge is $1.00 per 1,000 cu. ft. with a yearly minimum of $10.

The New Jersey Sewage Works Association dedicated the meeting to Harry P. Croft in recognition of 35 years of service with the New Jersey State Department of Health and of his 30th anniversary as chief engineer of that department. As a token of their esteem, the members of the association presented Mr. Croft with an engraved scroll marking the occasion and a television-radio-phonograph set.

To serve during 1948, the following officers were elected: Leslie E. West, president; John Struss and Sol Seid, first and second vice-president, respectively; and M. S. Kachorsky, secretary-treasurer.

Blasts test underground plant design

Preparations are well under way for heavy underground explosion tests to be conducted by the Corps of Engineers in central Utah and western Colorado late in 1948, engineers said at Salt Lake City last week.

As reported some months ago (*ENR* Oct. 2, 1947, vol. p. 439), the tests will be a continuation of experiments made before and during the war in which charges up to 2,000 lb. were used. The new program is designed to obtain information on heavier charges, in keeping with the increased firing power of offensive weapons.

Explosive charges to be tested will range from a few hundred pounds to more than 320,000 lb. of TNT, against underground structures in various types of soil and rock. The "targets" will be of a simple type to establish the structural damage from earth under shock.

Contracts have been let by the government to Morrison-Knudsen Co., Inc., Boise, Idaho, for construction; to Engineering Research Associates, Inc., St. Paul, for instrumentation work and studies, and the Colorado School of Mines for preliminary small-scale blast tests.

The tests will be conducted in the vicinity of Dugway and Castle Dale, Utah, and Grand Junction, in western Colorado.

Drouth puts three states "in debt" for water

Three years of continuous water shortages have left the three states of Colorado, New Mexico and Texas "in debt" under the Rio Grande compact, according to a report of the Compact Commission. Under the compact, each state agreed not to increase its use of the river water.

Even a possible above-normal runoff this spring probably would fail to even the score, particularly for farmers of central New Mexico whose district is the worst "in debt," the commission said.

For the first time in the ten-year history of the compact, Colorado ended up the year 1947 with a debt—of 18,800 ac.-ft.—when the water shortage of last year more than wiped out that state's credit of 37,300 ac.-ft. on hand at the beginning of 1947. That section of New Mexico within the Middle Rio Grande Conservancy District ended 1947 with a debt of 176,800 ac.-ft., an increase in its "debt" of 71,400 ac.-ft. during the year. Texas has 122,700 ac.-ft. deficit, the report said.

John Bliss, New Mexico state engineer, and Hubert Ball, engineer of the Middle Rio Grande Conservancy District, see in that district's plight an argument for the proposed $95,000,000 flood control and reclamation project proposed by the Army Engineers and the Bureau of Reclamation. Mr. Ball said recently that of about 100,000 ac.-ft. of water released from the district's El Vado reservoir on the Chama River last November, only about 70,000 ac.-ft. reached Elephant Butte. The remaining 30 percent was lost in seepage and evaporation in swamp areas above Elephant Butte—which the proposed project would remove. Governors of the three states are studying the Army Engineer-Reclamation Bureau recommendations for the project.

Flood control research gets under way in Iowa

State Senator George M. Faul, Des Moines, recently was elected chairman of Iowa's newly-created flood control research committee. The 12-member committee includes six legislators and six citizens—four of whom are engineers. Created by the 1947 special legislature session to make an extensive survey of flood control, water use, erosion and similar topics it must file a report with suggested new legislation when the legislature meets again next January.

West coast drouth condition worsens

Reservoir water-lines continued to drop in all parts of California last week as little or no rain fell to relieve the most severe winter drouth in the state's history. (*ENR* Feb. 26, vol. p. 316).

Rainfalls reported by the weather bureau in some areas of California and Nevada over the March 14 week-end will have little effect on the seriousness of the drouth situation, observers said. The extremely dry condition of the ground was expected to permit very little runoff from the precipitation.

Most affected were power users. The Pacific Gas & Electric Co. was given permission to curtail its power deliveries in the northern and central portions of California and the Sierra Pacific Power Co.—a utility that depends for a major portion of its supply on deliveries from PG&E—declared a "brownout" for the western portion of Nevada. Farm groups also voiced demands that the "brownout" be extended into southern California so that the Southern California Edison Co. surpluses could be added to the Northern California power pool.

Despite the water and power shortage, Santa Barbara—which has been on water rationing with fines for non-conformance—failed to approve a $2,000,000 bond issue for the raising of Gibraltar Dam, present source of city water. Officials said that voters apparently prefer to wait for construction of a Bureau of Reclamation project now before Congress.

San Diego temporarily gave up a portion of its Colorado River water from the recently completed aqueduct, to prevent a critical shortage in three neighboring communities—La Mesa, National City and Chula Vista.

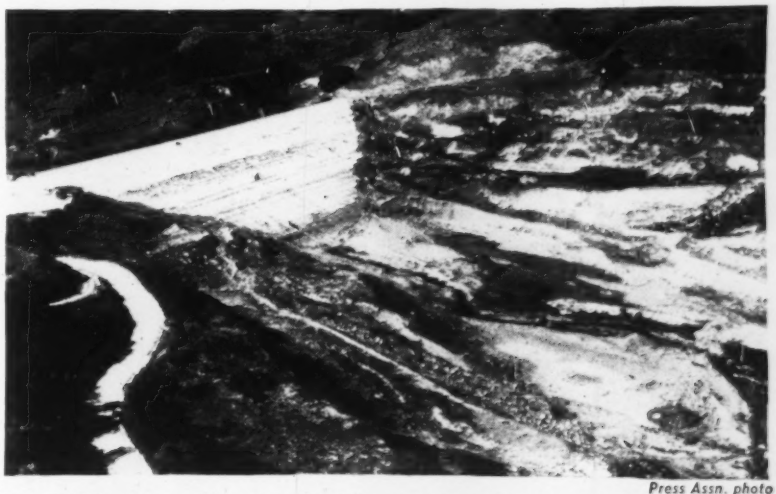
The California Public Utilities Commission authorized power companies to cut deliveries wherever and whenever needed. A "brownout" darkened most outdoor display signs and even street lighting was dimmed where safety was not impaired. When power consumption actually went up in spite of curtailments, PG&E started pulling substation switches for 30 minute periods, returning the lines to service only if consumption had been cut. Utility spokesmen said that farmers who had been delaying irrigation, had jumped in to get their share of electricity to protect their crops.

Penna. flood control work to get under way soon

Actual construction of Pennsylvania's $10,000,000 flood control program is expected to get under way this year, Gov. James H. Duff has announced.

The work will be carried out by the State Department of Forests and Waters, in conjunction with an advisory agency, The State Flood Control Commission.

For the most part, it will consist of headwater impounding dams which will be so constructed as to make possible their use for recreational purposes in addition to flood control functions.



Press Assn. photo

***Dry Gulch**—Normally, Almaden Reservoir, near San Jose, Calif., holds some 50,000 ac-ft. of water at this time of year, but last week continuing drouth had resulted in a dry reservoir and reduced Almaden Creek to a trickle.*

Funds sought to start USPHS building

Some $60,000,000 in cash and $75,000,000 in contract authority for the billion dollar hospital program of the U. S. public health service is contained in an appropriation bill (H. R. 5728) for fiscal year 1949 as passed by the House recently.

This money was contained in the general appropriation bill for the Federal Security Agency, of which PHS is a part, the Department of Labor, and Independent Offices. About the same time the House passed an appropriation bill (H. R. 5607) containing construction funds for the Civil Aeronautics Administration and the International Boundary and Water Commission.

The first bill also contains $1,372,990 for actual construction and $50,000 for the preparation of a master plan for Howard University in Washington, D. C. for work at this university the House also approved $866,750 in contractural authority.

This same measure contains $8,000,000 for contract authority for the National Cancer Institute to construct clinical hospital and laboratory facilities. For the National Institute of Health $5,000,000 is appropriated, and $25,630,000 in contract authorization supplied for the start of a large hospital and medical research center in the Washington, D. C., area. Contract authority for St. Elizabeth's Hospital in the capital totals $2,950,000 for construction.

Funds for the CAA include $3,000,000 in actual cash for planning and surveys regarding the construction of airports, and $1,835,000 for continuing construction at the National Airport, Washington, D. C. The bill also provides $37,000,000 in contractural authority for the CAA's $1.2 billion airport construction program.

Deny cities' jurisdiction over professionals

Attorney General Guy E. Williams of Arkansas last week ruled that the board of public affairs of a first-class city does not have jurisdiction over a professional firm or person.

In an opinion requested by the legislative and enforcement committee of the Arkansas Society of Professional Engineers, the attorney-general held that statute granting authority to boards of public affairs do not bring within their scope the matter of qualification for professional services. Such services, he said cannot be valued on a competitive basis similar to that of commodities.

L. A. Henry, chairman of the committee for the professional engineers, told Mr. Williams that some boards of public affairs recently have required engineering firms who offer their services to submit bids on a competitive price basis.

Excavating equipment sales are increasing

Shipments of excavating and earthmoving equipment during the fourth quarter of 1947 were valued at $121 million about 19 percent higher than shipments during the third quarter, according to the Bureau of the Census.

However, shipments of wheel-type heavy-duty industrial tractors decreased 17 percent during the quarter, from $5.9 million in the third quarter to $4.3 million in the fourth quarter, and shipments of portable well and blast-hole drills showed relatively little change during the quarter. In contrast, shipments of all other major types of excavating and earthmoving equipment showed increases during the quarter with those of power cranes and shovels increasing 22 percent; road construction and maintenance machinery, 21 percent; construction machinery for mounting on tractors, 12 percent; and tracklaying tractors, 27 percent.

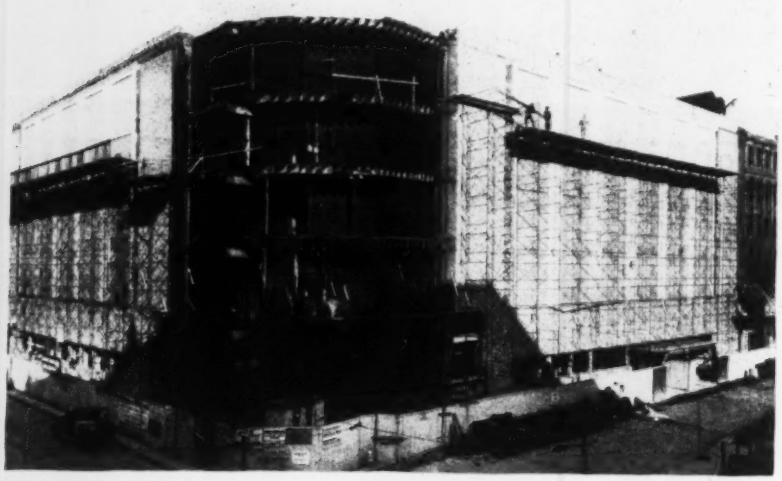
Factory shipments for export of excavating and earthmoving equipment (other than power cranes and shovels) increased 22 percent.

Lumber men, U. S. agency to talk industry control

Representatives of the lumber and plywood industries will be called to Washington late this month to discuss a voluntary industry control program with the Department of Commerce. Federal officials are concerned over continuing shortages of specialized types of lumber for housing construction.

Home building, the Commerce and Labor departments report after a special study, will probably reach an all-time high this year of 950,000 permanent non-farm units. This work will require 2.2 billion b. ft. more lumber than the record breaking total of 834,500 dwelling units in 1947.

The construction industry as a whole will use 26.5 billion b. ft. this year, it is estimated—and lumber production last year for all uses totaled about 36.6 billion b. ft.



***New Look**—Conversion of a 50-year-old mill-type building to a streamlined $1,500,000 International Trade Mart is to be completed in July in time for opening at New Orleans, La. Outside bearing walls are of heavy brick. Cast iron columns carrying the building are surrounded with brick pilasters, covered with cast stone, and glass blocks are placed between the pilasters. The building is supported by three rows of square sawmill piles sunk 6 ft. below street level, and columns not more than 15 ft. apart are driven 7 ft. below street level under the entire ground floor. The lower floor has a carrying capacity of 1000 lb. per sq. ft. and the second floor 750 lb. per sq. ft. Rathbone de Buys is architect, and Godt & Heft are consulting engineers.*

Concrete pipe makers urged to expand research in making, using conduit

American Concrete Pipe Association hears of studies now under way—Discusses phases of industry

Programs of research into the properties and uses of concrete pipe are now under way at two mid-west university laboratories, and the U. S. Army Corps of Engineers has allocated $10,000 for similar studies, members of the American Concrete Pipe Association were told last week.

Meeting at New Orleans, La., 178 delegates heard several speakers urge the need for increased research into all phases of their product during a four-day meeting.

Howard Peckworth, ACPA managing director, said that studies are now being carried forward at the St. Anthony Falls Hydraulic Laboratory, at St. Paul, Minn.,—where extensive culvert research is under way; and at the University of Illinois, where researchers are studying surface drainage of highways.

Additionally, he said the Corps of Engineers study reflected increasing interest in the use of concrete pipe in military construction. The corps' studies will develop information about design of mixes, methods of manufacture, and quality of concrete produced by various manufacturing methods.

Army developments

In this connection, Herbert E. Cook, chief, concrete research division, U. S. Waterways Experiment Station, pointed out possible savings through the careful design of mix, in a discussion of engineer practice in using concrete.

"Too often," Mr. Cook said, "needed research is postponed as being too costly or too slow, but in many cases it has been proved that benefits derived from research—both in improving the quality and reducing cost—far exceeds the cost of the studies. In my opinion, substantial savings can be made by accurately designing the mix, instead of using excess cement when necessary to make the concrete more workable."

The introduction of air entrainment, Mr. Cook added, has led many to believe that no additional research is needed in this field. But, with studies showing a wide variation in durability of air-entrained concrete, much research is still indicated.

"The variation in durability appears to be a function of the type and condition of the aggregate," he said. "Concrete containing inferior aggregates will not automatically become durable, simply because of air-entrainment. It is now required by the Corps of Engineers that any material prepared for use as an air-entraining admixture not only must cause a great improvement in the resistance of concrete to freezing, but must also reduce the tendency of the wet concrete to 'bleed.' Moreover, it must cause no reduction in compressive or structural strength."

Urge industry-wide tests

Harry W. Easterly Jr., production manager of the Concrete Pipe and Products Co., of Richmond, Va., urged industry representatives to unite their efforts in finding improved designs of concrete and methods of manufacture.

"Despite the growth of concrete pipe manufacture, there remain many questions to be solved through united research," he said. "Among these are the ideal mixing time for various mixes; effects of type of cement in the finished concrete pipe, effect of the specific gravity of the aggregates and proper methods of bedding, backfilling and distribution of load to the installed pipe.

"Among other things we need is more knowledge on admixtures such as fly ash, and the proper amount of air-entraining agents to be used in pipe manufacture."

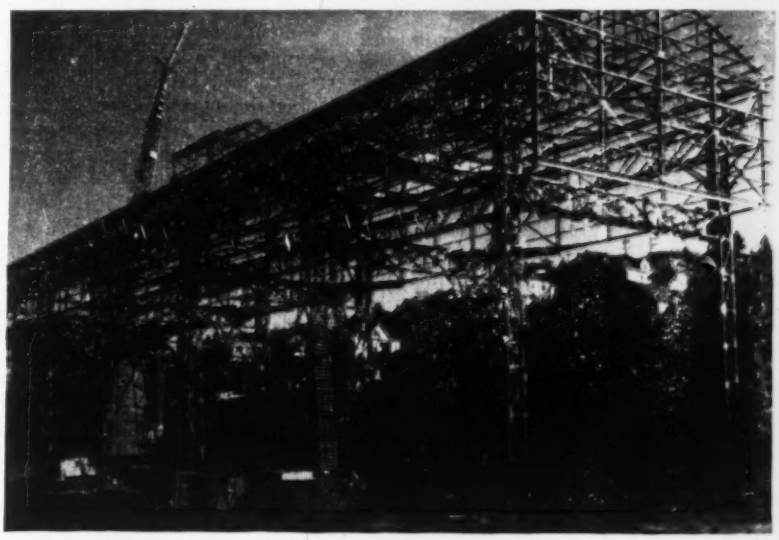
Other speakers discussed the need for good "housekeeping" in manufacturing plants and storage yards in the interests of safety and efficiency, and pipecoating materials.

J. A. Dunn, president of Hume Pipe of New England, Swampscott, Mass., was named president of the association, succeeding E. L. Johnson of Colton, Calif.

Hungry Horse Dam bids postponed to April 7

Opening of bids for the general contract for Hungry Horse Dam, which will be the fourth largest concrete dam in the world, has been postponed from April 1 to April 7 by the Bureau of Reclamation. This structure will be located on the Flathead River nine miles southeast of Columbia Falls, Mont., and it will have a maximum height of 520 ft. and will require about 3,000,000 cu. yd. of concrete (*ENR* Feb. 26, vol. p. 313).

The postponement has been made to give consideration for bids for supplying 2,500,000 bbl. of cement for the project. These bids will be opened April 2 at the Denver, Colo., office of the bureau. Bids for the dam will be opened at the government camp near the construction site.



***Sweet job**—Five steel tanks, each capable of storing 10,000 tons of raw sugar, will be in installed under this framework at the C&H refinery at Crockett, Calif. A conveyor system will deliver the sugar from ship to the top of the tanks, and an overhead crane with clamshell bucket will be used to unload the tanks when the sugar is needed in the factory. The peak of the roof is 140 ft. above ground level, and the whole structure is 450 ft. long and 80 ft. wide. Engineering was by L. S. Rosiner, San Francisco.*

Engineers submit Jap reparation report

Consulting group recommends against removal of productive facilities that can be used effectively there.

After an intensive five-month study of Japan's economy and industrial plants, a group of eleven engineering firms—organized as Overseas Consultants, Inc.—has recommended retention of the bulk of Japan's productive facilities to restore the country to 1930-34 economic levels and for production of goods now in short supply throughout the world.

The recommendation was included in a report to Secretary of the Army Kenneth C. Royall, made public Mar. 10.

All primary war facilities would be removed or destroyed, leaving Japan without military power of any kind.

The consultants said it will take Japan until 1953 to get its civilian production and economy back to 1930-34 levels. They recommended that surplus capacity of only five basic industries be removed as reparations. These, with annual production capacities, are: Nitric acid, 107,000 metric tons; synthetic rubber, 900 metric tons; shipbuilding, 385,000 gross tons; aluminum-magnesium fabricating, 50,000 metric tons, and magnesium reduction, 480 metric tons. Their value, in 1939 yen (approx. 27½ c.) is 172,269,000. Adding primary war facilities, valued at 1,475,887,000 yen (1939), the total reparations would amount to 1,648,156,000 yen.

Oppose previous suggestions

Part of the assignment was to check recommendations of a previous report submitted by the State, War and Navy Coordinating Committee on suggested reparations of 20 basic industries.

The engineers took issue with the prior report for two reasons: First, they claim the amount of productive capacity is assumed too high, and second, removal of parts of these industries would greatly handicap Japan in becoming self-supporting—regarded in the report as the greatest step toward peace in the Orient. "Furthermore," the report said, "any industrial production capacity beyond needs for a minimum civilian economy should be used in Japan for export production to alleviate world shortages. Such plants, if moved, would be out of production for a long time, thus their output would be lost to world markets."

At a press conference in New York the consultants pointed out that out of a total steel rolling capacity of 4,200,000 tons annually, about 800,000 tons annually will be required for restoration work in Japan for the next five years. Cement production—6,000,000 tons annual capacity—is virtually at a stand-still for lack of coal. Timber products are scarce at present, because of wartime devastation of forests, and structural clay products are also in very short supply. The coal situation is still bad, but slowly improving.

Overseas Consultants, Inc., is made up of the following firms: American Appraisal Co.; Coverdale & Colpitts; Ebasco Services, Inc.; Ford, Bacon & Davis, Inc.; Jackson & Moreland; Madigan & Hyland; F. H. McGraw & Co.; Sanderson & Porter; Standard Research Consultants, Inc.; Stone & Webster Engineering Corp., and J. G. White Engineering Corp. Clifford Strike, of the McGraw Co., is president; J. T. Lotz of Stone & Webster is vice president, and G. V. T. Burgess of Coverdale & Colpitts is treasurer.

Test North Carolina stream-pollution law

The North Carolina State Supreme Court last week was asked to decide on the constitutionality of the state's 33-year-old law prohibiting pollution of rivers.

The case was brought to the Supreme Court by Attorney General Harry McMullan, who filed an appeal from a ruling of a lower court which held that the statute is not constitutional. The lower court's decision resulted from state prosecution of the Glidden Co., owners of a manufacturing plant on the Yadkin River in Caldwell County, on the state's charge that the company has permitted the discharge of deleterious substances inimical to fish inhabiting the water.

The company countered with the charge that its actions were not a breach of the criminal law and that the law itself is not according to the constitution.

USPHS sets exams for sanitary engineers

Examinations for appointments in the regular corps of the U. S. Public Health Service in the grades of assistant sanitary engineer (1st lieutenant) and senior assistant sanitary engineer (captain) will be held during June of this year, the service said last week.

About 15 appointments are to be made. Application forms and information may be obtained from the Surgeon-General, U. S. Public Health Service, Washington 25, D. C.

Reno, Washoe County to build disposal facilities

Conceding failure in attempts to unite city and county sanitary authorities, Reno, Nev., and Washoe County have acted to construct separate sewage disposal facilities to cost a total of $1,554,000.

Reno has let a $61,299 contract to George Miller, Reno, for an outfall line for the first unit in a $1,000,000 project. A bond issue has been approved.

Bids for the $554,000 county project will be sought early this summer if voters endorse a bond issue.

The Reno system will include a pumping station and an expanded disposal plant that will handle 16 mgd. and remove 85 percent of the solids.

The present city plant has a capacity of 8 mgd. with 65 percent removal of solids. It will be increased by the addition of two 170-ft. clarifiers, two biofilters 170 ft. in dia. and a secondary digester with 70-ft. dia. and a depth of 30 ft.

The county project will bring sewage facilities for the first time to a new and rapidly expanding residential area a few miles south of Reno.

The project calls for the laying of 2 mi. of 18-in. main, 2½ mi. of 15-in. main, three miles of 12-in. main and ¾ mi. of 27-in. outfall line. It also calls for construction of a disposal plant with a capacity of 600,000 gpd., to be built 3 mi. south of the Truckee. This plant is expected to cost about $120,000, will give complete treatment, with a 95 percent removal of solids.

Virginia governor signs Ohio River Compact

Virginia, last of the eight states needed for completing the Ohio River Compact (*ENR* March 4, vol. p. 333) on March 5 joined the long fight against pollution of the Ohio River, when Governor William M. Tuck signed a bill giving him authority to enter into the sanitation compact with the other states.

Next step will be appointment of three commissioners by governors of each of the states involved.

States participating are New York, Pennsylvania, West Virginia, Virginia, Ohio, Kentucky, Indiana and Illinois.

The compact will benefit 18,000,000 persons in 200,000 square miles of Ohio Valley territory. The stream cleanup will cost approximately $300,000,000 and will require about 10 years for completion, according to Hudson Biery, Cincinnati, who led the long battle to organize the compact.

OBITUARY

William L. Puffer, 87, of Wellesley Hills, Mass., a former associate professor at Massachusetts Institute of Technology and later a consulting engineer who advised on construction of subways in Boston and New York, died March 8 in Laconia, N. H. He was graduated from M.I.T. in 1884.

Paul Hart Francis, 56, Navy engineer, died Feb. 28 in Westmoreland Hills, Md. Mr. Francis was a graduate of Brown University, where he taught engineering for several years. He became senior engineer in the building of aircraft power plants in the Navy's Bureau of Aeronautics 10 years ago.

Hugh Stone, 62, Marysville, Calif., engineer of Yuba County since 1936, died March 3.

Roland L. Turner, 65, a retired civil engineer, died March 2 at Buffalo, N. Y. He was graduated from University of Maine in 1904 as a civil engineer. For 17 years he was grade crossing engineer for the Erie Railroad in Buffalo. In 1921, Mr. Turner began private practice in Buffalo and at Garden City, N. Y., and represented the Lehigh Valley and New York Central railroads.

William W. McClevy, 57, a civil engineer and purchasing agent for the Virginia highway department, died in Richmond March 3. He was a 1913 graduate of Virginia Military Institute. After service in the Army in the first world war, he joined the highway department and in 1919 was appointed assistant resident engineer at Roanoke and in 1923 he became district engineer and served for 15 years. In 1938 he became office engineer at Richmond and later purchasing agent.

Alan H. Knight, 49, the engineer who superintended construction of the Jefferson Memorial in Washington, D. C., and the U. S. Naval hospital at Bethesda, Md., died at Ellicott City, Md., Feb. 29.

Oliver J. Bandelman, 48, city engineer of Huron, S. D., died recently.

Gerald Jones, 53, engineer of Winnebago County, Iowa, for the last 18 years, died recently.

Hans C. Hanson, 72, first highway engineer of Lake County, Minn., died recently in Two Harbors, Minn.

Col. K. D. Nichols to head special weapons project

Col. Kenneth D. Nichols, former district engineer for the Manhattan project at Oak Ridge, Tenn., has been named to succeed Lt. Gen. Leslie R. Groves as head of the armed forces special weapons project, it was announced early in March. Colonel Nichols, who is now on duty at the U. S. Military Academy, West Point, will be promoted to the temporary rank of major general. He was assistant to General Groves when he headed the Atomic Energy Project and will also succeed him as a member of the military liaison committee of the AEC. General Groves' retirement was effective Feb. 29 and at that time he joined Remington Rand, Inc., as general manager of the scientific research division (ENR, Feb. 12, Vol. P. 228).

Begin 2,342-unit housing project in New York

Work has been started on the construction of 111 buildings, to contain 2,342 apartments, in the second section of the Glen Oaks Village development, according to George M. Gross, president of the Gross-Morton Co. The development is to be a 3,800-family rental garden-apartment community at Union Turnpike and 247th Street, Queens, New York City.

This second section of the $30,000,000 development will cover a 140-acre tract. The first section of 576 apartments, now half-occupied, is rapidly nearing completion.

The section will also include a 15-acre shopping center, designed for a department store branch, chain stores, gas station, theatre, library and extensive parking facilities. The shopping center, which supplements the 25,000 square feet of store area in the first section fronting along Union Turnpike, will represent an estimated expenditure of $1,250,000. Parking facilities for 1,000 cars in the business center is being provided.

MAJOR MEETINGS

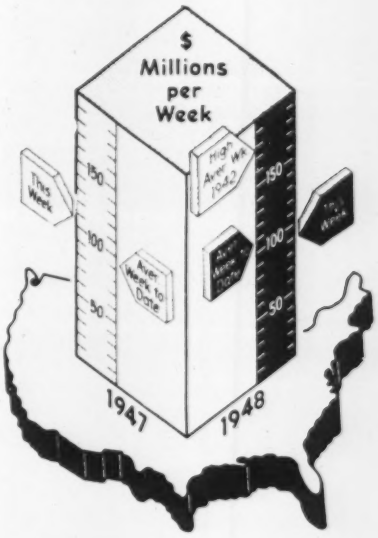
Chicago Technical Conference, Stevens Hotel, Chicago, Ill., March 22-24.

American Society of Civil Engineers, spring meeting, Hotel William Penn, Pittsburgh, Pa., April 7-9.

Building Officials Training School, Drake Hotel, Chicago, Ill., April 26-29.

State Sanitary Engineers, Annual conference with Public Health officials, Washington, D. C., April 26-30.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Mar. 18 1948	Cumulative 1948 (12 wks.)	Cumulative 1947 (12 wks.)
Federal	$18,712	$284,826	$81,752
State & Mun.	38,877	416,302	285,100
Total Public	$57,589	$701,128	$366,852
Total Private	32,729	585,656	760,892
U. S. Total	**$90,318**	**$1,286,784**	**$1,127,744**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1948 (12 wks.)	Cumulative 1947 (12 wks.)
Waterworks	$5,053	$38,628	$26,146
Sewerage	3,576	36,293	19,324
Bridges	6,959	52,040	33,197
Highways	12,271	157,138	114,589
Earthwork, Waterways	12,955	139,738	26,408
Buildings, Public	11,055	230,309	101,525
Industrial	8,264	148,201	179,513
Commercial	23,805	381,275	468,083
Unclassified	6,380	102,562	159,959

NOTE: Minimum size projects included are: Waterworks and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (12 wks.)	Cumulative 1947 (12 wks.)
NON-FEDERAL	$714,211	$233,371
Corporate Securities	386,887	23,688
State and Municipal	327,324	209,683
Total Capital	**$714,211**	**$233,371**

ENR INDEX NUMBERS

Index Base		100	1913	1926
Construction Cost	Mar. '48	438.41	210.74	
Building Cost	Mar. '48	329.03	177.85	
Volume	Feb. '48	234	102	

EDITORIALS

VOLUME 140 NUMBER 12

March 18, 1948

Few Supervisory Engineers

NOT MANY professional employees are going to be classified as supervisory by the National Labor Relations Board. That is the conclusion to be drawn from the first two decisions of the board bearing on this important question since passage of the Taft-Hartley Act. That act gave engineers and other professional men the right to bargain collectively with their employers through organizations independent of the unions representing other employees in the same company. It did not, however, expressly prohibit the employer from classifying engineers as "supervisory" to escape the necessity for bargaining with them as a group. This is just what was attempted in the two cases now decided by the board. One related to lawyers employed by an insurance company and the other concerned time-study engineers employed by a machinery manufacturer. The decision with respect to time-study men is especially significant. In effect, the board said that the mere fixing of a scale by which management of the company rated other employees did not put the time-study men in the supervisory class because they had nothing to do with the actual application of that scale. While the finding that these men exercise no management function may not be very palatable to those who hold that engineers occupy a peculiar place between labor and management, it will be a great help to the engineering employees in big corporations who feel the need for collective bargaining and yet do not wish to cast their lot with the big industrial unions who know little about their peculiar problems and care less.

Dissipation of Highway Funds

A DANGEROUS AMENDMENT to the federal-aid highway legislation now in Congress has been proposed and seems destined to receive favorable action by the subcommittee on roads of the House of Representatives as this issue goes to press. It would redefine the terms "secondary and feeder roads" and "principal secondary and feeder roads" as used in the Federal Aid Highway Act of 1944 (which the new bill would extend) to include "all county and township roads irrespective of the volume of traffic over such roads." The 1944 act said that these terms included "farm-to-market roads, rural free delivery mail and public school bus routes." By inference it excluded minor county and township roads from the federal-aid program. The proposed amendment clearly brings them in. If approved, this amendment would set a bad precedent and could only result in wasteful dissipation of federal-aid highway money. Giving every local politician a claim on that money will mean that it will be spread very thin, all to no good end, instead of being concentrated on worthwhile improvements of major roads in the secondary system.

Anniversary of Note

TWENTY YEARS AGO, in 1927, the first high-early strength portland cement was introduced to the American market. The event is memorialized in a booklet, properly titled "A New Era in Concrete", just published by the Lone Star Cement Corp., manufacturer of Incor, the trade name of that first cement.

By attaining a strength in 1 day that had required 7 days or longer with normal portland cements, the new cement permitted a speeding up of concrete work that literally revolutionized the art. Fewer forms had to be used, since they could be stripped sooner and re-used. Roads, sidewalks and floors could be built without costly and inconvenient delays waiting for the concrete to harden. Bridges and buildings could be completed more rapidly. And winter construction with concrete was made more practicable and less costly because the period of necessary heat protection was radically shortened.

All these things are accepted as normal today, which makes it all the more appropriate to recall the initiative and foresight displayed two decades ago by Lone Star, then known as the International Cement Corp. Although high-early-strength portland cements had been used in Europe (apparently having been developed first in Austria about 1913, and later in Switzerland and Germany) no great amount of service or research data was available and, of course, none that was directly applicable to American raw materials and manufacturing conditions.

The Army Engineers in World War I had experimented with quick-hardening cements, mostly of alumina type, for fortifications and gun emplacements, and thus there was some appreciation in the United States of the advantages of high-early-

strength. Beyond this, however, knowledge stopped, and it was Lone Star that assumed the leadership in first seeking the research data, and, in 1927, launching a more finely-ground, harder-burned, American-manufactured portland cement on the market.

Today, high-early-strength portland cement is made by virtually every U. S. cement manufacturer, and it has behind it two decades of successful service. The booklet, referred to above, emphasizes this success by presenting the results of a condition survey of many of the pioneer high-early-cement jobs. The oldest concrete paving, at Limedale, Ohio, for example, yielded a 20-year average strength from five cores of 7,988 psi. Continuing strength gains and high durability after 20 years is also noted for other pavements and structures.

To what research indicated has been added the proof of service. The anniversary of the introduction to American construction practice of a high-early-strength portland cement is one to be noted.

Steel, Cement and Public Works

CONSTRUCTION of public works in 1947 increased 24 percent over 1946 according to *Engineering News-Record* "contract-award" figures, and 40 percent according to the U. S. Department of Commerce "construction-put-in-place" figures. For this year, another 20 to 25 percent increase is estimated. In view of the continued high level of private construction, the problem of adequate supplies of construction materials becomes immediately apparent. The unknown foreign-aid-plan requirements for construction materials further complicates the situation.

It may be noted that the above increases are in terms of 1947 dollars, and not of physical construction volume, in which the increases are smaller. Nevertheless, they are increases, and they must be met by greater materials supply. The principal question that consideration of physical volume raises is why, on a physical volume in 1947 of only 60 percent of the peak year of 1928, there should be any construction material shortage. The answer is largely found in the fact that today large segments of manufacturing capacity and manpower, which may have been available to construction materials under 1928 economic conditions, are otherwise engaged. Moreover, it is today, and not in historical perspective, that the materials supply must be considered.

Two basic materials of construction, steel and cement, are revealed by the U. S. Department of Commerce to be particularly vulnerable to any increase in construction demand. Total steel consumption for new construction in 1947 of 5,927,000 tons is estimated to mount to 6,200,000 tons in 1948. All of this increase (and more, since private construction will take less than this year), is accounted for by the expected rise in public works. Whereas public works required 18.5 percent of construction steel in 1947, it will take 23 percent in 1948.

Reinforcing bar steel, it is estimated, by the Commerce Department will follow the same pattern. No increase is contemplated for private construction, but public works will need 91,000 tons more —from 36.6 percent of the total in 1947 to 41 percent in 1948.

Cement, turned out at near-capacity production in 1947, and with stocks at the lowest level in years, will be required in larger volume for public works in 1948 than last year, and of an 8-million barrel estimated increase in demand, 7-million barrels is for public works. About 48 percent of all cement used in 1948 is estimated to go into public works.

There can be no doubt of the great need for public works of every description —water supply, sewerage, highways, flood control, water conservation, schools, hospitals and airports— but if the estimates of the Commerce Department portray an accurate picture a real dilemma is faced by those responsible for laying out the programs. If competition for materials with private works and foreign aid is intensified, costs are bound to rise. If materials are unavailable in sufficient quantity, projects cannot be finished on time. If public works are pushed regardless of consequences, both private construction and the foreign aid plan may suffer.

Statistically, public works, even after the contemplated 1948 rise, will account for no more than the classically accepted one-third of total construction. But in view of the materials situation, this ratio may prove to be too high. What to do about public works is one of 1948's most knotty problems.

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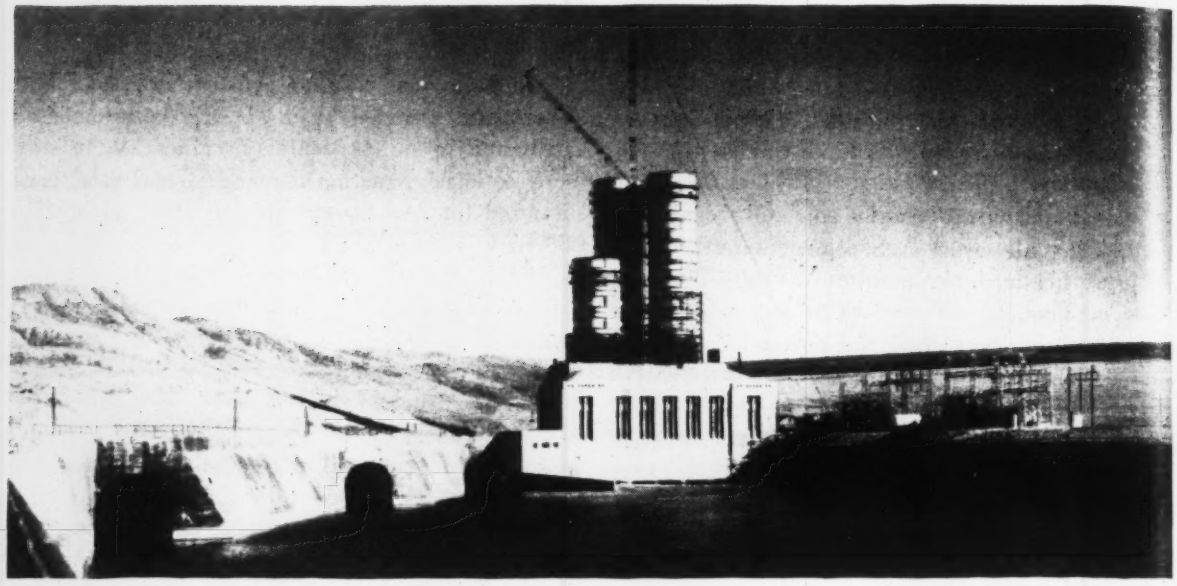


Fig. 1. Three steelplate surge tanks, one for each penstock, rise behind the Ft. Peck powerhouse. Steel frame being erected around tanks will support thin precast concrete slabs of insulated housing.

Fort Peck Hydro Plant Provides for Three Power Units

Henry Miller
Consulting Engineer, Chicago, Ill.

***Contents in Brief**—Economical design to fit site conditions and meet future power demands characterizes the hydroelectric installations at Fort Peck dam. A single steel-lined pressure tunnel is connected by a triple wye to short penstocks for three turbo-generators. Two are now in service; a third will be installed when needed. Large surge tanks over the penstocks, supported on a unit foundation with the powerhouse, are protected by an insulated thin-shell housing of pre-cast concrete on steel framing. The penstocks themselves are inclosed to prevent freezing in winter and to supply a cool air plenum chamber for ventilating the powerhouse in summer. Hot air from the generators can be used for heating the powerhouse in winter and can be cooled in either of two ways during the warm months.*

PHYSICAL conditions and economic considerations led to the design for the Fort Peck Dam of a compact, closely knit hydro plant with special features that adapt the powerhouse and penstocks to the limitations of the site. Provision is made for eventual installation of three 50,000-hp. turbine units, connected by individual penstocks to a single pressure tunnel. Three large, interconnected surge tanks, to take care of pressure differentials in the penstocks, are erected in structural combinations with the powerhouse.

Of four 21-ft. 8-in.-dia. tunnels constructed in connection with the dam during the 30's for initial diversion and ultimate outlet use, one, the shortest, was steel-lined for 3,118 ft. downstream from its control shaft to serve as a pressure conduit for power purposes (*ENR* May 13, 1937, vol. p. 693). The powerhouse was located as close to the portal of this tunnel as available space and foundation conditions would permit.

Design of substructure

Foundation materials at the proposed powerhouse location were explored with test borings, as well as several 36-in.-dia. calyx holes, and found to consist of a deposit known locally as "Bearpaw" shale, with a bentonite seam extending diagonally across one corner of the powerhouse area and sloping downstream. It was found advisable to remove the material in and above this seam and replace it with concrete. From field and laboratory tests it was determined that the shale would sustain a load of 5 tons per square foot with an ample factor of safety.

Detailed studies indicated that it was most practicable to place the surge tanks adjacent to the powerhouse. The wall between the supporting structure of the surge tanks

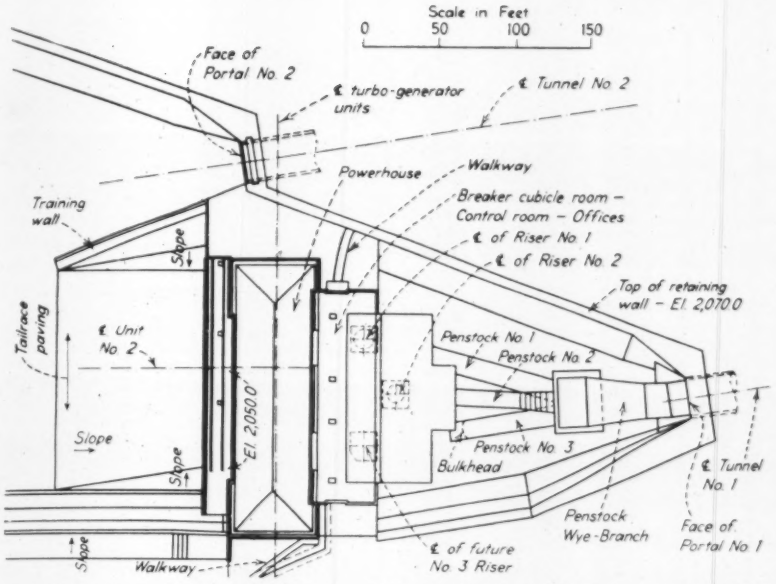


Fig. 2. In triangular space between retaining walls of outlet structure are located three wye-branch penstocks and their surge tanks (above the risers) to serve three turbo-generators in powerhouse. Penstock No. 3 is temporarily bulkheaded. Surge tanks and powerhouse rest on combined spread footing.

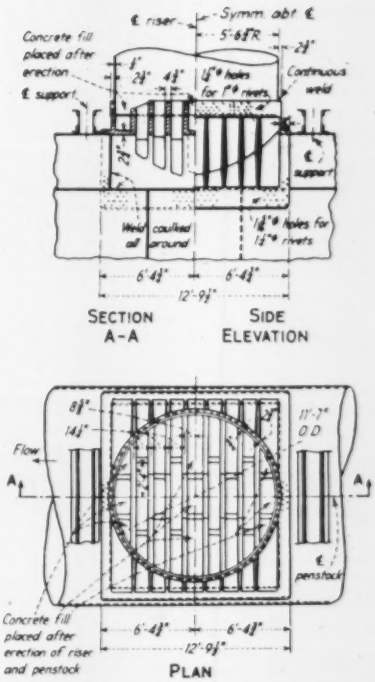


Fig. 3. Cast-steel riser connection on penstock is reinforced with vertical ribs extending across the opening to carry band stresses of the pipe across the gap.

and the powerhouse was thereby utilized as a common support for both structures. The footing for the powerhouse and surge tanks was considered as one combined spread footing.

Bids for the powerhouse superstructure, penstocks and surge tanks were received just at the time the United States entered World War II, and, as a result, actual construction was suspended. During the war, however, need for power reached a point where it became advisable to install one 50,000-hp. unit, omitting the surge tank because of the large tonnage of critical material, plate steel, required. To operate this unit without a surge tank, the governor was slowed down to 42-sec. action, and a temporary water rheostat was cut in to limit the speed rise of the unit that would occur from loss of head.

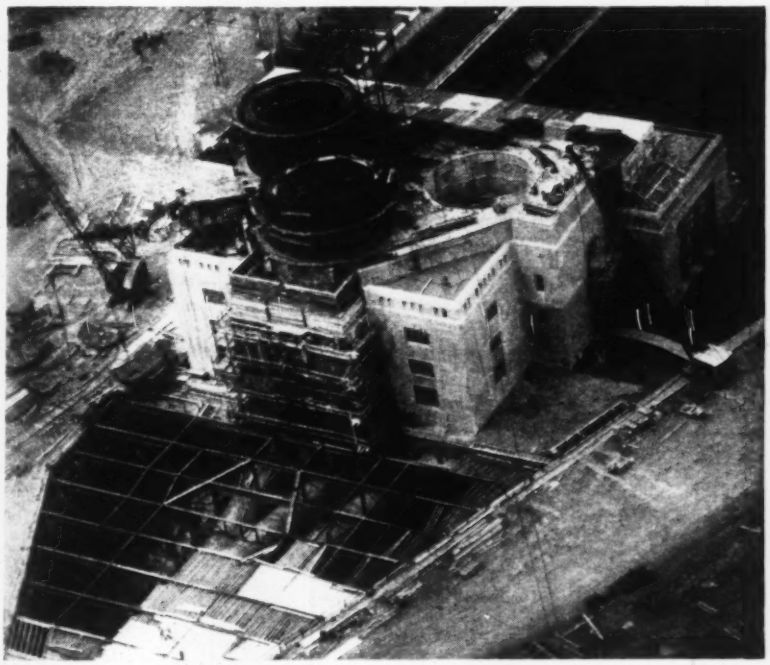


Fig. 4. Unified design of Fort Peck hydro plant puts three surge tanks in close proximity to powerhouse, utilizing common dividing wall as a support for both structures. Three penstocks (in left foreground) are covered over by reinforced-concrete deck on a structural steel frame.

The 50,000-hp. turbine unit installed during the war is now operating. A smaller unit of 20,000-hp., installed in the space provided for a second 50,000-hp. unit, will go into operation this winter. At some future date, a third turbo-generator of 50,000-hp. is to be added. The 20,000-hp. unit is designed to operate at a normal head of 75 to 205 ft., and each 50,000-hp. unit at a normal head of 100 to 205 ft.

Generators are designed for 38,889-kva. output by the large unit and 16,667-kva. output by the small unit, both operating at three-phase, 60 cycles, 13,800 v. Station-type, metal-clad, compressed-air-operated, air circuit breakers, rated at 1,200 and 3,000 amp., perform all required low-tension bus switching at the generator voltage.

For long distance transmission,

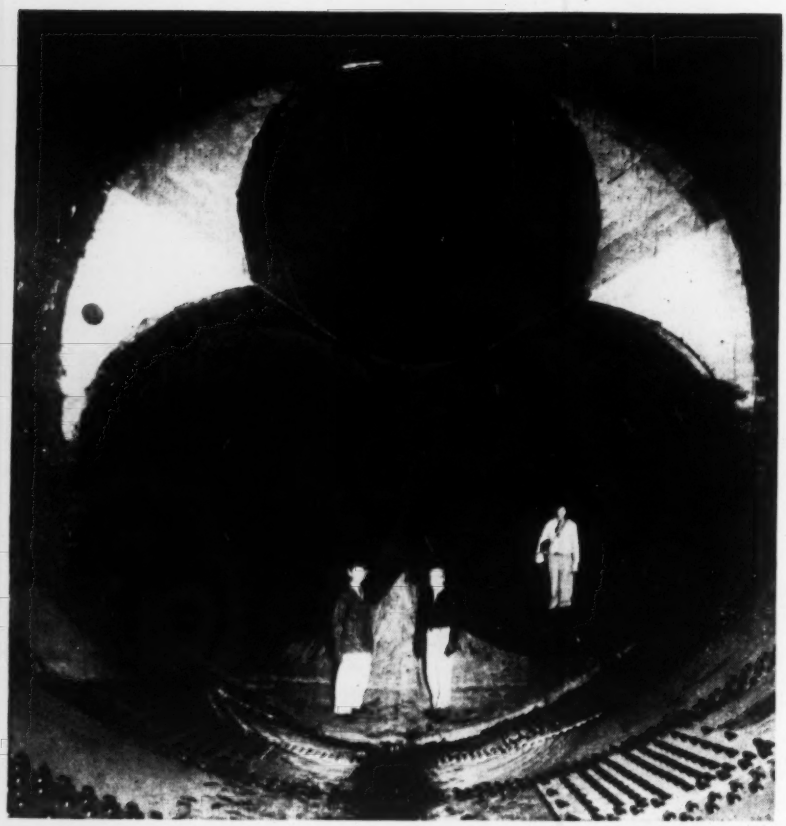


Fig. 5. Streamlining of concrete fill at upstream end of wye-branch simplifies fabrication problem in constructing transition from 34-ft.-dia. cylinder into three 14-ft.-dia. penstocks.

outdoor-type power transformers step up the voltage to 33 kv., 115 kv., and 161 kv. In the future, outdoor-type oil circuit breakers, rated 600 amp. continuous at 115 kv., will be installed in the substation yard for the 115-kv. lines.

Originally hydraulic studies were based on the use of a single surge tank for the three units, requiring a tank about 60 ft. in diameter to compensate for a sudden outage of all three units. Structural requirements for such a large tank, with nearly 150 ft. of water depth inside, led to a decision to use three individual tanks with interconnected pipes.

The three tanks thus determined are nearly 40 ft. in inside diameter and more than 160 ft. high, exclusive of risers. They are designed to provide 30 ft. of surge at maximum pool level with 5 ft. of freeboard. The tanks are connected to the penstocks by 11-ft dia. risers for the large units and an 8-ft dia. riser for the small unit. In addition, the tanks are interconnected, one to another, by two 5-ft dia. pipes.

Riser connections

For the surge tanks to function properly, they must have rather definite size openings between the penstocks and tanks. These openings can best be determined by model experiments or, in time, by actual operating experience. To allow ample room for increasing or decreasing the openings, the riser pipes connecting the penstocks to the surge tanks are purposely over-sized, and the openings are throttled or choked at the points where the risers join the penstocks.

Ordinarily, small tee connections have saddle flanges which are designed to carry all the stresses around the openings. Stresses at the penstock connections, however, are of such magnitude that normal saddle-type flanges are quite impractical. In addition to the saddle flanges, the tee connections are designed with vertical ribs, extending across the opening, computed to carry the band stresses of the main pipe across the opening (Fig. 3). By closing off any number of openings between ribs, the desired throttling effect can be

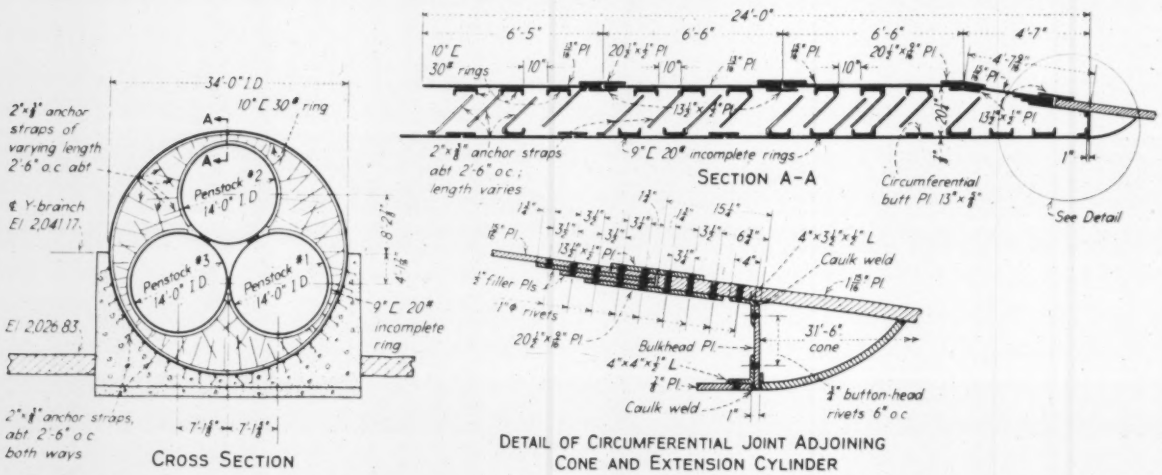


Fig. 6. Wye-branch cylinder surrounding three penstocks is filled with concrete between penstock pipes and cylinder wall. Note welded anchor straps and steel bulkhead water stop.

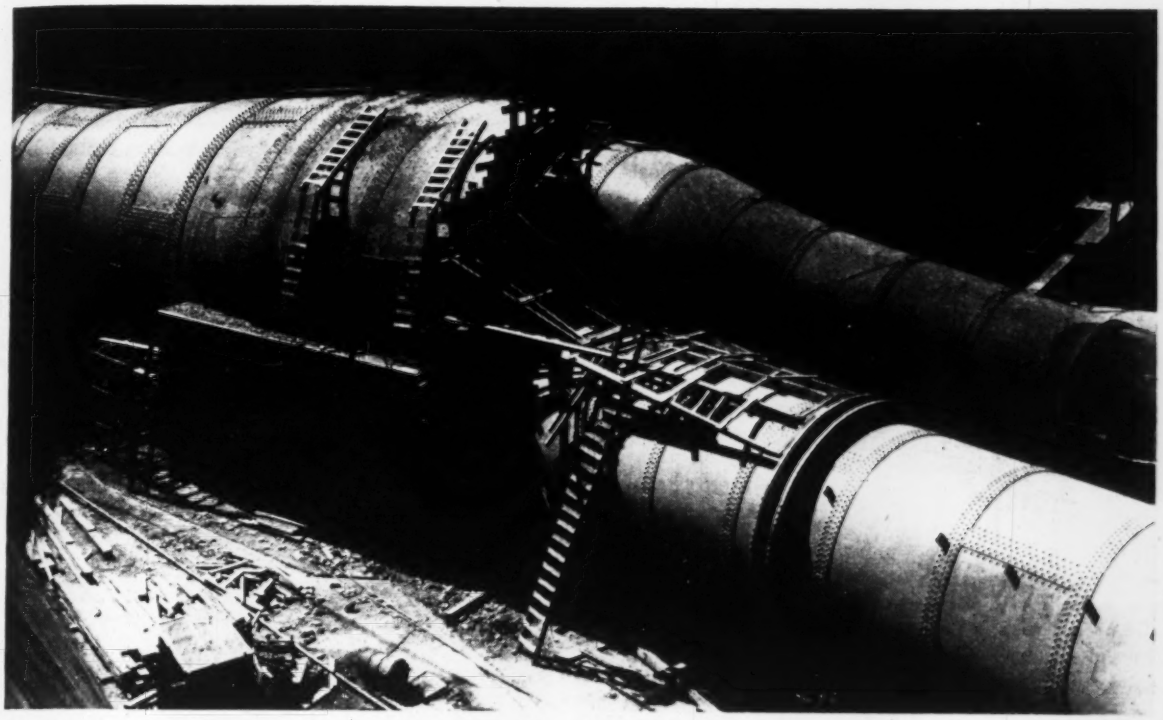


Fig. 7. Three penstocks take off from wye-branch cylinder enlarged to 34 ft. from tunnel diameter of 24 ft. 8 in. Penstock No. 2, coming out of upper half of cylinder, is reduced from 14-ft. to 11-ft. dia. to serve temporary 20,000-hp. unit.

obtained. Laboratory test on models proved this method to be very effective and at the same time established the amount of opening to be provided for complete control of the unit under various conditions of operation.

To form an air space around the surge tanks, a completely insulated thin-shell housing, consisting of a structural steel supporting frame with precast concrete slabs attached to it, incloses all three tanks. Because the tanks are arranged in triangular order for physical reasons, the housing is in a general way triangular in shape and is architecturally treated.

Use of precast slabs in this manner is unique, as they have no masonry of any kind to back them. Supporting lugs cast on the backs of the slabs bear on the horizontal members of the structural steel framing, and bolts cast into the slabs hold them in place with steel clips. Each slab is individually supported, with a $\frac{1}{4}$-in. joint allowed at the top, bottom and sides. No mortar is used in the joints, and no vertical load is applied to any slab. All joints are backed with steel and filled with an elastic caulking compound.

All precast slabs are $1\frac{3}{4}$ in. thick, and all typical slabs are 3 ft. in width by 6 ft. in height. To produce a hard-finished surface matching the finish on the powerhouse superstructure, all slabs were cast on absorptive form liner. For proper weathering of the thin slabs, it was deemed essential to use a high-strength, high-density concrete, and the specifications called for a strength of 9,000 psi. at 28 days.

To obtain the desired quality, $3\frac{1}{2}$ parts of $\frac{3}{4}$-in. crushed stone from the Thornton, Ill., quarries was used with one part of fine Ottawa, Ill., silica sand, and one part of standard portland cement; the water content in the mix was 4 gal. per bag of cement. The slabs were vibrated face down on a vibrating table. Tests showed the slabs to run from 13,000 to 14,000-psi. compressive strength at 7 days, far in excess of the specification requirements.

Penstocks and wye branch

Penstocks are 14-ft. inside diameter for the 50,000-hp. units and 11-ft. inside diameter for the 20,000-hp. turbine. The 11-ft. penstock is enlarged to 14-ft. inside diameter at the wye branch to facilitate, in the future, replacing the 20,000-hp. unit with a 50,000-hp. unit. A 14-ft.-dia. stub end, at present bulkheaded off, is provided for the future third unit.

Steel-plate lining of the tunnel, 24 ft. 8 in. in inside diameter, is extended a short distance downstream of the portal, where it is connected to the three 14-ft.-dia. penstocks through a three-branch wye (Fig. 7). To fabricate in the simplest way a completely streamlined three-branch wye that would carry all stresses, the connection between the tunnel liner and the penstocks was made in the following manner:

The three 14-ft.-dia. penstocks were carried horizontally a distance of 24 ft. into a steel-plate cylinder of 34-ft. diameter. A number of anchor straps were welded (at one end only) to the penstocks and to the 34-ft.-dia. cylinder, and the space between the penstocks and cylinder wall was filled with concrete, shaped at the upstream end for streamlined entrance into the penstocks (Fig. 5). Between the penstocks and the cylinder wall a steel-plate bulkhead was installed to act as a water stop (Fig. 6).

In the three-branch wye, the concrete acts merely as a transmitting agent for stresses. All outward stresses due to water load are carried by the steel plates of the penstocks or large wye-branch cylinder. At its up-

stream end, the 34-ft.-dia. cylinder plate of the three-branch wye is connected to the tunnel liner by means of a steel plate cone, thereby completing the steel-plate water passage from the control shaft to the turbines.

Penstock valves

Each penstock is equipped with a butterfly valve at, or near, the entrance to the turbine scroll case. For each larger unit, of which ultimately there are to be three, the disk of the butterfly valve is 16 ft. in diameter. When the valves are in a closed position, the horizontal hydraulic thrust is taken by the scroll plate from the disk trunnion supports into the powerhouse.

For the present, unit No. 3 penstock, being stub-ended and bulkheaded off, throws a horizontal load on one side of the three-branch wye. To avoid twisting or undue stresses in the structure, the stub-end penstock was extended to the powerhouse and strutted against the upstream wall.

To prevent freezing or ice formation in the penstocks during the extremely low temperatures of the winter months, a covering deck of reinforced concrete on structural steel supports is placed over the triangular space bounded by the tunnel portal, the powerhouse and the wing walls of the outlet structure. The inclosed space thus formed serves still another purpose, as an air cooling chamber for the powerhouse.

The superstructure of the powerhouse is entirely of architectural concrete with glass block windows. The interior is ventilated by forced air coming in at a single intake, installed on the roof deck of the penstock inclosure, as described below. All the air entering through this intake is filtered by a battery of mechanical self-cleaning filters.

Air cooling system

Water carried by the penstocks varies in temperature from about 35 to 56 deg. F. throughout the year. These low temperatures on the large exposed surfaces of the penstocks furnish an ideal cooling system for the relatively hot air taken in during the summer months. To utilize this cooling medium, the air intake was located on top of the decking at the upstream end of the penstocks, adjacent to the tunnel portal. Thus all the air taken in travels nearly the full length of the penstocks and is cooled by the time it reaches the various rooms supplied in the powerhouse.

To carry off and cool the hot air emitted by the generators, several alternates have been provided. The hot air may be discharged into the penstock room to be cooled and recirculated during the summer months, or it may be discharged into the various room for heating purposes during the winter. Finally, if desired, the air passages of each generator can be isolated and the hot air circulated through water coolers and back to the generator.

Water for these coolers is obtained through a direct tap on the penstocks. Because the pressure in the penstocks is much higher than the maximum of 20 psi. allowed on the generator cooler tubes, the water for this purpose is first discharged into an open tank at a fixed elevation. The flow into this tank is automatically controlled to maintain water at a definite level, but, should trouble develop with the control, an ample-size overflow is provided to assure no increase in pressure in the cooler supply line.

If, during the winter months, the generators should operate at partial load and supply insufficient hot air for space heat, or should the generators be inoperative, space heat is furnished by gas heaters, further supplemented by unit electric heaters in rooms occupied by personnel.

When construction of the insulated surge tank housing is completed, a separate space heater will heat the ambient air around the surge tanks to prevent freezing. Hot air will be carried by a duct from the heater to the top and there distributed around the outside of the tanks. As the air cools, it will be carried down by gravity and by suction.

Design of the powerhouse, penstocks and surge tanks was made by the Harza Engineering Co., of Chicago, Ill., by which the writer was formerly employed. All design work was carried out under the direct supervision of the division engineer, Missouri River Division, Corps of Engineers, Department of the Army, Omaha, Neb., and all construction work has been under the immediate direction of the district engineer, Fort Peck District, Corps of Engineers, Fort Peck, Mont.

Cities Are Taking Anti-Smoke Action

Major cities are striving for effective smoke-control action to reduce atmospheric contamination.

The American Public Works Association reports that Pittsburgh, long notorious for its smog, is in the vanguard of municipalities taking decisive action to curb soot and fumes. Other cities with anti-smoke campaigns include Akron, Chicago, Detroit and Salt Lake City.

Pittsburgh's anti-smoke drive is aimed particularly at residences and has a unique legal ace-in-the-hole: an ordinance which prohibits any local fuel dealer from delivering smoke-producing coal to places not equipped with smoke-eliminating devices.

The Pittsburgh smoke-control ordinance was adopted in 1941 but its full application was delayed by the war. On Oct. 1 it was extended to cover 142,000 coal-burning private homes in the city. Smoke from all buildings, railroads and factories is also regulated under the ordinance.

Akron has passed a comprehensive smoke-control ordinance which regulates soot, dust and poisonous fumes, and provides for inspection and licensing of all fuel-burning equipment. Violators of any section of the new law may be fined up to $100 for each day's offense.

In Detroit, the municipal law department recently held that the city may buy and sell fuel to its residents if coal producers withhold fuel from the market. After passage of Detroit's smoke-abatement law, some coal dealers threatened to keep their product off the market in protest against stringent regulation. More than 30 cities in the Detroit area are cooperating on anti-smoke plans.

Salt Lake City also adopted new smoke abatement regulations recently. In Chicago, city smoke inspectors are working with stoker manufacturers on a new method of preventing discharge of large amounts of soot during early morning "fire ups."

Bridge Erection in the Wilderness

M. McDonald
Resident Engineer, Pacific Division,
Dominion Bridge Co., Ltd., Lachine, Que., Canada

Up in the Peace River district of central British Columbia, Canadian bridge building crews have recently completed a major highway crossing of the Pine River on the Hart Highway under difficulties uncommon in more settled areas. Steel was fabricated in Vancouver, shipped 1,500 miles by rail and then trucked to the site 50 miles west of the town of Dawson Creek. It was delivered in the late winter to take advantage of good hauling conditions and the ice bridge at the site, as half the steel had to be taken across the river. A 20-ton crawler crane, serving as a traveler, was the principal piece of erection equipment used to set the 460 tons of steel 80 ft. (elevation of the bottom chord) above the river. Cantilever erection was used for the three main truss spans.

Containing three deck spans (160, 280 and 160 ft.) in a continuous truss layout, flanked at each end by 50 ft. simple truss spans, triangular in shape, the bridge is situated at a point where the river bed is about 400 ft. wide, with shale banks rising steeply on either side to benches about 100 ft. above the river. The trusses are 25 ft. deep, and set 15½ ft. center to center. Seven lines of 12-in. stringers, with 18-in. floorbeams at 20 ft. centers carry an 18-ft. concrete roadway.

Erection commenced on June 18, 1947, the 50 ft. simple truss span at one end being erected first and decked over with timber to provide a working platform for a 20-ton crawler crane. Using this span, securely tied down at the abutment as an anchor arm, 80 ft. of the 160 ft. span was erected as a cantilever, the crane advancing on timber decking as required. A temporary steel bent, 80 ft. high, made up of chords, diagonals and bracing from the center span, was then erected and the cantilever arm landed on it by slackening off on the tie-downs at the abutment. Erection then proceeded to the next pier, after which the temporary bent was dismantled.

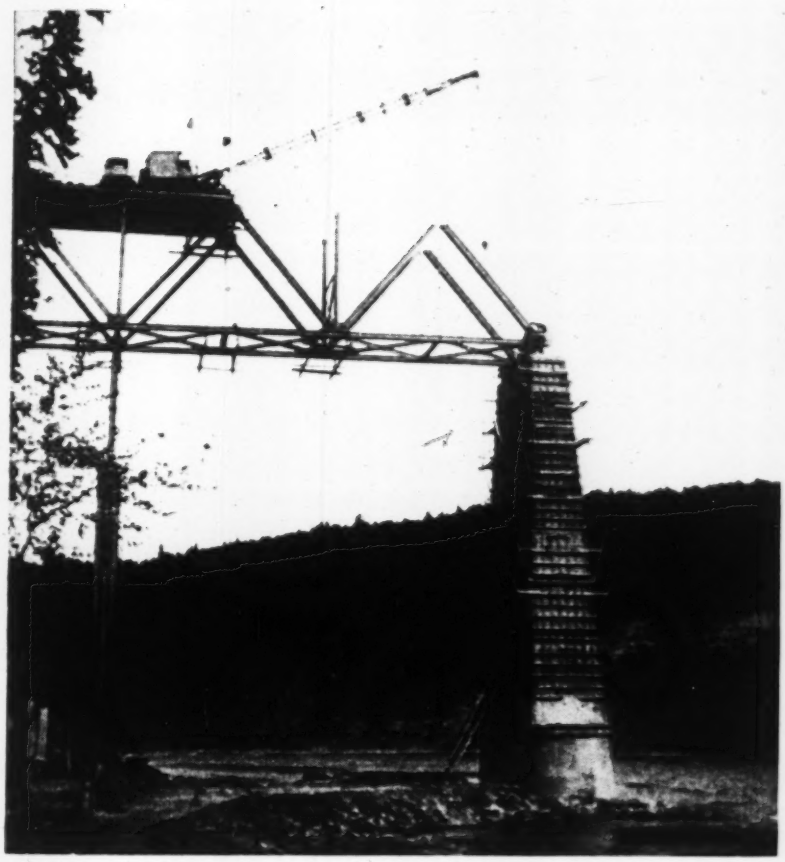
Erection of the center span was carried out 160 ft. from the pier by the same procedure although the last 10 ft. section of this cantilever arm was erected with a jinniwink instead of the crawler crane, to keep excessive weight off the span. All equipment was then transferred across the river by ferry and an identical procedure followed on the other half of the bridge.

Closing the main span

To close the main span the shoreward ends of the 160 ft. spans were lowered onto temporary shoes an amount sufficient to raise the deflected center span up to its dead load camber position. At the same time this caused openings at the closure point of ⅝ in. on the bottom chord and 1⅜ in. on the top chord. Closure was then made by pulling one half of the bridge forward on its roller bearings to close the bottom chord, and jacking the ends of the 160 ft. spans to close the top chord. These ends were then jacked farther to set the permanent shoes and induce the requisite stresses in the trusses.

Closing operations were completed on August 14. The spans, which had only been pinned and bolted during erection, were then riveted. Pouring of the concrete deck started before riveting was finished September 4, and was completed by September 20. The bridge was officially opened for traffic on October 4.

The Pacific Division of the Dominion Bridge Co., Ltd. was the contractor for the fabrication and erection of the superstructure. Construction of the foundations was carried out by the Northern Construction Co. and J. W. Stewart, Ltd., who were also subcontractors on the concrete deck. J. U. Copeman was resident engineer for the Department of Public Works of British Columbia.



Crawler crane traveler sets steel for last panels of the first 160 ft. span on the 700 ft. long Pine River bridge in British Columbia.

Fig. 1. All the stone added over the old porous concrete surfacing is delivered and unloaded with floating equipment.

New Upstream Slope Protection Added On Santee-Cooper Earthfill Dams

***Contents in Brief**—To provide better protection for the upstream slope of the earthfill dams of the Santee-Cooper project in the areas where wave action can occur, the old 10-in. thick porous concrete surfacing is being broken up and surfaced with 6 to 12 in. of filter stone and a heavy riprap blanket. In constructing the latter, 6 to 12 in. of filter stone is first added followed by a maximum of 3 ft. 6 in. of large stone. Delivery and placing of the stone is expedited by use of special floating equipment developed during the war for military use.*

To END THE DIFFICULTY caused by the failure of a porous concrete slab to provide adequate protection for the upstream slope of the earthfill dams of the Santee-Cooper project in South Carolina, work is now underway on a $4,243,000 project calling for the placing of about 750,000 tons of stone on this slope. Results to date indicate that adequate protection will be obtained by the procedure being followed, which includes the use of special equipment to expedite delivery of the stone and its installation.

Completed in 1941 as a PWA project, the Santee-Cooper development is operated for power production and navigation benefits by the South Carolina Public Service Authority. The project includes the 50-ft. high Santee Dam across the Santee River, the 78-ft. high Pinopolis Dam blocking a branch of the Cooper River, and a 7-mile long diversion channel permitting water from the reservoir created by the first dam to flow into the second reservoir.

Both dams are, for the most part, long earthfills and together they have a total length of 12 miles. Construction of 28 miles of dike was also required to create the two large reservoirs. When the dams and dikes were built, a 4-in. thickness of pea gravel surfaced with a 10-in. thickness of porous concrete was selected for protection of their 1 on 3 upstream slopes (*ENR* May 23, 1940, vol. p. 706).

Porous concrete eroded

This concrete, which was designed to have a minimum compressive strength of 2,000 psi. at 28 days, was made with ordinary portland cement and a coarse aggregate of ¾-in. maximum size, no fine aggregate being used. The concrete has proven unsatisfactory because it has eroded appreciably in those areas where extensive wave action occurs. In a few cases the erosion has been so severe that almost the entire thickness of the slab has been cut through.

To overcome this difficulty a number of strengthening methods were considered. These included surfacing the porous concrete with a continuous reinforced concrete slab built by ordinary methods, surfacing of the old slab with several inches of pneumatically placed concrete, addition of a continuous blanket of steel sheetpiling over the old slab, construction of

Fig. 3. Where the porous concrete is to be surfaced with riprap it is first broken up with a pavement breaker pulled up and down the slope by a crawler tractor, which also tows the compressor supplying air for the breaker.

an asphalt pavement over the existing surfacing, and covering the old concrete with a heavy blanket of riprap. Final decision was to advertise for bids for only two of the strengthening programs. These were the reinforced slab and the riprap blanket.

The outcome was award of a contract for the placing of 750,000 tons of protective stone on the upstream slope of 11 miles of the earth dams. Addition of the riprap is limited to the area between El. 55 and El. 78, which compares with El. 88 for the crest of the dams and a maximum pool level of El. 75. Above El. 78 the porous concrete will be left undisturbed and no riprap added over this part of the slab, as no erosion has taken place in this zone.

Before the stone is added the existing pavement between El. 55 and El. 76 is broken up to increase the coefficient of friction between the concrete and the riprap. This work is accomplished with a converted heavy pneumatic pavement breaker mounted on a 3-wheel pneumatic-tired chassis that permits the rig to be readily moved up and down the slope.

Breaker operated from tractor

Travel of this rig along the slope is controlled by a line from the drum of a crawler tractor, which also pulls the 315-cfm. portable compressor supplying air for the hammer. After the breaker has traveled down the slope for the desired distance, its position is shifted about 15 in. farther along the dam for the next trip by means of the steering wheel controlling the position of the front wheel of the rig. The breaker is then ready for another trip up the slope. It is supplied with air at about 120 psi.

Only two men are required to operate the rig—the operator of the tractor and workmen assisting in shifting the position of the breaker along the dam. Inspection of the broken pavement below the water surface by divers has shown that the rig is nearly as effective submerged as above the surface. To date the rig has had to operate at a maximum depth of 15 ft., but before the project is finished it is expected the reservoir will be at normal upper pool level, placing the breaker under 20 ft. of water at the lowest point of travel.

Since the contractor is responsible

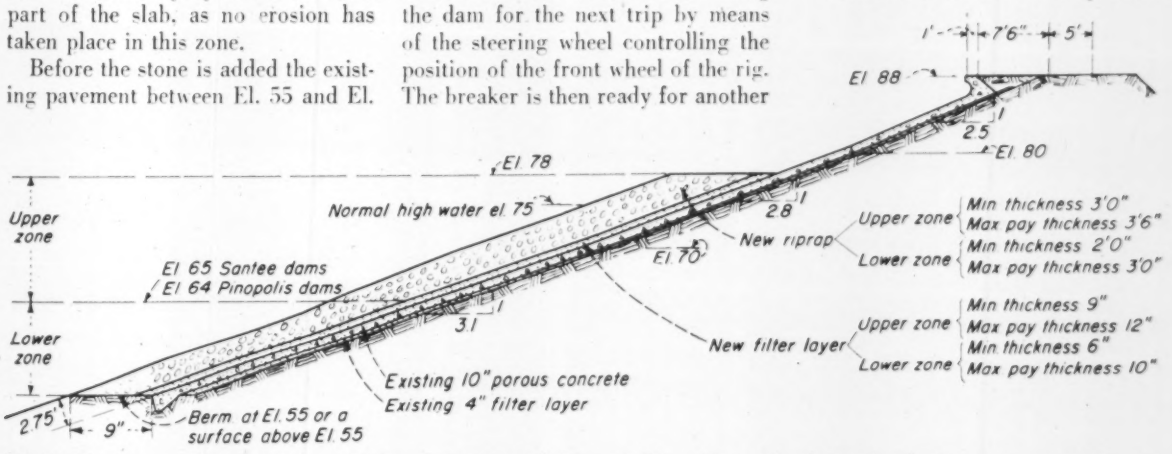


Fig. 2. The new surfacing is being added only between El. 55 and 78. Above the latter level the porous concrete protection has proven adequate and it is being left undisturbed.

Fig. 4. Stone for the riprap work is delivered by LCM's developed for military work. When operations are shut down the floating equipment is tied along the dam to avoid displacement of the porous concrete.

for protecting the broken pavement from displacement by wave action, the placing of the protection stone follows closely behind the breaking operation. Moreover, when operations are shut down at night, barges are tied along the water's edge in the area of the broken pavement to provide protection until work is resumed.

Filter stone added first

The first stone applied over the broken pavement consists of a thickness of 6 to 12 in. of filter stone with the smallest size stone ¾-in. in diameter and the largest 5 in. All of the stone is delivered by floating equipment (Fig. 1). The filter stone is unloaded with a clamshell bucket handled by a crawler crane equipped with a 50-ft. boom and mounted on a 35x52-ft. barge made up of steel pontoon cells or boxes of the type used so widely during the war by the Navy's Seabees. By exercising care in unloading the filter stone, the operator of the crane is able to obtain a sufficiently uniform thickness that no leveling up of the material is required, either below or above water.

Between El. 55 and El. 65 the filter stone is surfaced with 2 to 3 ft. of riprap of which not over 5 percent can pass through a 4-in. dia. opening and not more than 10 percent is pieces weighing above 200 lb. It is further required that not less than 40 percent and not above 60 percent of this stone shall be pieces weighing over 100 lb., while the maximum size stone is limited to 300 lb.

This stone is unloaded by a clamshell bucket handled by a 40-ton full-revolving, oil-fired floating crane with a 100-ft. boom. Most of this riprap is being placed below water, since with the work to date the reservoir has been at about El. 70. By careful placing of the stone the need to spread the riprap is avoided.

For the remainder of the slope being surfaced, or from El. 65 to El. 78, a thickness of from 3 to 3.5 ft. of larger size riprap stone is added. Specifications require that not over 10 percent by weight of this material be less than 4-in. in diameter, the maximum size stone be limited to 1,300-lb. pieces, and that the longest dimension of the larger stone be 5 ft. or less. Added graduation requirements are that above 50 percent but below 70 percent of the material be pieces weighing over 100 lb., from 20 to 60 percent be pieces weighing over 300 lb., and that less than 10 percent but not more than 30 percent shall be 1,000-lb. stone or greater.

Addition of riprap for the upper zone follows closely behind that for the lower slope. This material is placed with a crawler crane with a 55-ft. boom. This crane is also mounted on a 35x52-ft. barge made of steel cells.

New quarry opened

No quarries of sufficient capacity to produce the large amount of stone required for the job are available in the vicinity of the Santee-Cooper project. To overcome this problem a quarry has been opened up near Columbia, S. C., about 100 river miles upstream from the dams. A processing plant with an hourly capacity of 100 to 150 tons has been set up and facilities constructed for loading the stone onto floating equipment. A good grade of granite is being quarried.

Transportation of the stone from the quarry to the desired location is distinguished by the use of twelve self-propelled craft of the type used so widely in the war and known as LCT's. Each of these units has a capacity of 275 tons. Also used are 32 barges of 150 to 300 tons capacity. The latter are moved with two conventional tugs and five war-developed craft known as LCM's.

Minimum travel time for one of the self-propelled barges with load from the quarry to the desired location has been 9½ hr. and the average 16 hr. Operation of the craft is expedited by use of ship-to-shore radios on the LCT's and by the contractor's project manager using a seaplane to travel about the job.

Work was begun on the project in June and as of last December, a little over over one mile of the dam had been completed. One long shift is worked. The contractor's crew at the dam totals about 27 men.

Contrary to a statement that appeared in *ENR* Feb. 13, 1947, vol. p. 244, little erosion on the land side of the earthfills has occurred. All of these slopes were surfaced with topsoil and at many places a satisfactory stand of grass has been established. At other locations a legume cover has been planted to provide adequate protection against erosion and to build up the soil sufficiently to support grass if this proves to be the more desirable cover.

For the South Carolina authority J. H. Moore is chief engineer, and E. L. Dodson is in direct charge of inspection work. The general contract is held by Grannis, Thompson and Street, Charlotte, N. C., for which Mark C. Fox is project manager; Craig Gaskell, assistant manager, and H. M. Todd, project engineer. The quarry is being operated by Congaree Quarry Co., Alcoa, Tenn., with Claye Lambert acting as superintendent.

Harza Engineering Co., Chicago, consultants on the original development, are consultants on the present program. For the Federal Works Agency, which is aiding in financing the construction described, C. L. Vickers is project engineer.

Building Russian Morale

***Editor's Note**—The following report from the Moscow office of McGraw-Hill World News seems to indicate that the Russian system of building morale at home by criticizing what others do is still going merrily on. The quotation calls for little comment other than to say that the railway work criticized by the Russian newspaper involved relaying of only 300 ft. of track to close a gap in a relocated section of the Missouri Pacific main line where that line crosses the old line at a higher level. Obviously, no mechanization of track laying or special equipment was called for. Pre-assembly of the few sections of track required was adopted in this case as a logical step in speeding the whole operation. American railway engineers never have favored that method of laying long stretches of track.*

Engineering News-Record hit the headlines of the Feb. 20 issue of *Gudok*, daily newspaper of the Soviet Ministry of Railways, which in a recent article headed "Imaginary Records of American Railway Builders" claimed that a job of American track laying reported by *ENR* as taking four hours, could have been done in one to one and a half hours in the Soviet Union.

The *Gudok* article is signed by N. Shadrin, head of the Railway Building Faculty at the Moscow Institute of Transport Engineers, and by G. Novozhilov. A full translation of the article follows:

"The front cover of the American magazine 'Engineering News-Record' for Nov. 20, 1947, depicts mechanized track laying. The caption under the photo explains that prefabricated links were laid in reconstruction of a section of the Missouri-Pacific Ry.

"Prefabrication of links and mechanized track laying are the latest word in railway construction. One might expect that in the pages of the American journal we would find a description of perfected labor organization and high tempos attained in reconstruction. But the figures cited in the article cause surprise. Although the Soviet reader has known that mechanization of track-laying work in America has lagged behind, it was hardly conceivable that it was on such a low level.

"The magazine reports that track links were laid on one section of the mainline where a curve was being straightened. Traffic was stopped at eight am. after a passenger train passed through. At 11.30 am. the last link was laid, and a 12.05 exactly on schedule, the article sensationally reports, a train passed over the new line.

"What technical means were employed and what time rates attained in this work?

"Train traffic was interrupted for four hours on the line in operation. But if only the working time is counted, then during 3.5 hours a rock fill of 411 cu.m. was completed and 91.4 meters of track were laid.

"In other words, 27 minutes were spent on laying a link. Such low tempos are explained first of all by the level of technical means employed. The design of the steam crane which laid the links is so outdated that in our day it seems like some kind of relic. Among modern machines this mechanism looks like Don Quixote's Rossinante. Such cranes cannot work continuously, and an intermission must be arranged every time it is necessary to bring up a supply of links. How can there be high tempos?

"Our builders have long since rejected track laying by crane, a method resorted to only at the time the Turksib was built. For the past twenty years or more soviet constructors and inventors have created diverse track-laying machines distinguished by high productivity. We make reference to the widely applied track-layer of Platov. This mechanism equipped with a crane of new design works rhythmically and uninterruptedly. It lays track by links at the average rate of 550 to 600 meters an hour. Thus, per link 1.25 to 1.4 minutes are spent, not 27.

"The conclusions from this comparison are self-evident; the level of mechanization of track-laying in the USA has remained the same as it was in the period of the railway building 'fever' at the end of the last century. During a half century, not one step ahead!

"So much for technique. But what about the labor organization described in the magazine.

"The peculiarity of American construction consists in that it is done by separate firms and contractors who are wholly led by their own experience. Preliminary planning in which new principles of the most perfected—flow—organization of the technological process might find a place is inadequately developed. It is precisely the old American 'contracting' set-up of construction that retards the application of flow methods.

"This is graphically evident even in the photograph mentioned above. The eye is struck by the fact that many people are engaged in laying the link. Apart from observers one can count 11 persons, and all 11 carry out some kind of work.

"A still larger number of workers is concentrated on the section where the track is lifted and the prepared link is packed with rubble. All is done exclusively by hand without mechanical tamping or portable compressors. In the background of the photo is seen the crane: it is idling, waiting, until the track is prepared for it.

"These characteristic features impressed by the lens of the camera testify to the absence of even elementary technological processes and non-rational use of labor force.

"A few words about the rock fill. Two tractors were used in making it, tractors equipped with devices for earth removal—bull-dozers. Also here it is impossible to discover record figures: 411 cu.m. in 3.5 hours—that is lower than the quota we set for similar mechanisms.

"For the information of the editors of the American magazine: an interruption in train traffic of one to one and a half hours instead of four hours would have been sufficient had the track section with the volume of work indicated in the article been reconstructed under our Soviet conditions, with application of our Soviet technique.

"So what, properly, are American railway builders boasting about?"

Critical Comments on . . . .

Diversion Factors for Combined Sewers

Thomas R. Camp • Charles P. Reming • Gordon M. Fair • Henry W. Taylor
John C. Stevens • M. LeBosquet, Jr. • L. L. Sphar
G. T. Sparrow • Charles S. Spencer • Richard Hazen

HOW DIVERSION FACTORS for discharge of sanitary and storm sewage from a large system of combined sewers might be computed by relating organic load of sewage to the purifying power of the receiving stream was told in a recent article (*ENR* Nov. 1947, vol. p. 734). In describing this procedure, the authors, Robert J. Theroux and Robert L. Meek of Moore & Owen, consulting engineers, Indianapolis, Ind., invited critical comments and expressed the hope that further development of the method would result in improved application.

From the following appraisals by sanitary engineers several basic criticisms are presented: (1) Bacterial pollution is of greater significance than biochemical oxygen demand passed into streams during overflow periods; (2) Peak dry-weather flows, which may be two to four times the average dry-weather flow, should be considered; (3) The degree of treatment-plant purification should be included in an analysis of this type; and (4) The refinement in calculation may not be justified by the accuracy of measurable factors and the influence of immeasurable variables.

As a result of studies on Massachusetts' Merrimac River, reports Thomas R. Camp, consulting engineer, Boston, Mass., it is found that the BOD discharged during overflows is much less important than bacterial pollution, particularly if the stream is utilized for drinking water or recreation. While a light, short overflow might greatly contaminate the river with bacteria, such a discharge exercises little influence on BOD in the river. Mr. Camp concludes that "there is no effective way to avoid bacterial pollution short of complete separation of the sanitary sewers."

Contending that peak dry-weather flows be used in the design of interceptors, Mr. Camp states that a "diversion factor" of 2.02 (in the author's sample calculation) would not accommodate dry-weather peaks in most systems and "that some sewage would go overboard even without rain."

Several contributors suggest that the degree of treatment-plant purification be included and evaluated in the design analysis. In this connection, Messrs. Sphar and Sparrow of Parker and Hill, Seattle, Wash. state: "As presented, 100 percent BOD reduction in the plant is implied, and this is, of course, not obtainable."

The question is raised concerning relative accuracy of field measurements and office calculations. It is generally felt that the basic factors cannot be determined with sufficient precision to justify the use of refined calculation that the method requires. Moreover, it is pointed out that certain variable hydrological conditions that influence the results cannot be evaluated closely. Details of these and other discussions that will be of interest to sanitary engineers follow.

Bacterial Pollution More Important

Thomas R. Camp
Consulting Engineer
Boston, Mass.

This is an interesting attack on the problem but in our opinion it is quite inadequate. Our findings in connection with abatement of pollution in Massachusetts' Merrimac River Valley Sewerage District, indicate that BOD discharged to streams during overflow periods is of relatively small significance and that bacterial pollution is of great and controlling significance, particularly in cases where the stream may be used for recreation purposes or for drinking water. Our studies indicate that if interceptors are designed for peak dry-weather flow, which is approximately twice the average dry-weather flow in these municipalities, only about three percent of the sewage escapes to the river through overflows. This represents a relatively unimportant portion of total BOD in the effluent from complete treatment. Our studies also indicate that overflows may be expected from five to six times each month during the summer if interceptors are designed for about twice average dry-weather flow and that little reduction in frequency of overflows can be expected no matter how large the interceptors are designed. Overflows may be expected three times each month if interceptors are designed for ten times average dry-weather flow. Hence the conclusion that it is not economical to attempt to intercept more than the peak dry-weather flow. It may be further concluded that there is no effective way to avoid bacterial pollution short of complete separation of the sanitary sewers.

The paper completely ignores bacterial pollution. In our opinion bacterial pollution is the important consideration since even a small short-time overflow grossly pollutes the river whereas a small short-time overflow has little effect upon BOD in the stream. The authors have not considered duration of overflow. If their 100 mgd. storm is a summer flash storm, peakflow will be of short duration and will discharge little total poundage of BOD into the stream. A lesser storm of three-days duration might be much worse. A

short heavy slug of BOD in the river will quickly spread out and have less effect than a continuing smaller discharge.

The authors have based their analysis on the average dry-weather flow with no consideration of peak dry-weather flows which may be two to four times the average. In the example they arrived at 2.02 times as their "diversion factor." This would not take care of dry-weather peaks in most communities and some sewage would go overboard even without rain.

The degree of purification to be accomplished by treatment works is not mentioned in the paper. In the authors' analysis an economical balance must be struck between percent purification by treatment works and allowable BOD permitted to overflow. If the authors are going to permit a certain amount of sewage to overflow, they must obtain a better percentage removal from intercepted sewage. Conversely, if they intercept more sewage, the percent removal therefore will not need to be so great.

Presumably the authors have used the worst conditions of the receiving stream—that is, minimum flow, maximum temperature, etc. Yet, based on such analysis, the authors arrive at very low diversion factors,—too low in our opinion to accommodate peak dry-weather flow. It is our opinion that interceptors should always be adequate to care for peak dry-weather flow with a small factor of safety.

Use of Factor Needs Clarification

L. L. Sphar & G. T. Sparrow
Parker and Hill, Consulting Engineers
Seattle, Wash.

The authors are to be commended for pointing out the advisability of designing diversion chambers to suit specific requirements. Their approach to the problem is fundamentally sound except that the effect of degree of treatment at the plant is not discussed in the text nor included in the sample calculation. With this modification and certain clarification, the method should prove valuable when applied with proper appreciation of the practical limitations involved.

The conditions stipulated in the sample calculations indicate that the city must have a plant capable of at least 75 percent BOD reduction, based on dry-weather requirements. The calculations should include the effect of some such a plant. As presented, 100 percent BOD reduction in the plant is implied, and this is, of course, not obtainable.

Assuming 85 percent reduction of BOD when the plant is carrying peak flow, and re-computing for a 100 mgd. storm flow to the sewers, the over-all diversion factor works out to be 1.42. By successive trials it is found that the critical storm is one which adds 55 mgd. to the sewers, and the corresponding diversion factor is 2.10.

The authors state that the critical storm in their example is 60 mgd. and the diversion factor 2.02. To arrive at this result, it is necessary to assume a plant which provides 88 percent BOD reduction, which leads us to suspect that the omission exists only in the sample calculations.

The method of using the over-all diversion factor to arrive at factors for the various chambers requires clarification. The BOD ratios to be used must be the ratios of weighted BOD of the entire flow of sewage *at the critical storm dilution* to the BOD of sewage with critical storm dilution at each diversion structure. Usually, there is a wide variation in the proportions of storm and sanitary flow in a large system. This would not be taken into account if the ratios of dry-weather BOD strengths were used.

Character of surface drained, time of concentration, presence of industrial waste sources, etc., introduce complications which should not be overlooked. The authors do not indicate that they have not taken these factors into account but their meaning has not been clarified.

Some practical limitations seem worth noting. Plants must be designed to handle peak flows which may reach them. It may not be economically justifiable to provide capacity for the chance critical local storm which may occur once or twice yearly when the stream is at minimum flow. In general, it would seem reasonable to allow the stream to be temporarily overloaded for short periods on such occasions. This would mean the selection of more moderate assumptions in the design of diversion structures.

Some engineers will undoubtedly attempt to apply this method to situations where gathering of complete data involved cannot be undertaken. To these the hazard of making incorrect assumptions must be made clear. The assumptions—for example, that storm water contains the same dissolved oxygen and BOD as the stream at minimum flow, or that the deoxygenation and re-aeration constants of the stream at minimum flow will apply when the critical storm is added, may lead to diversion factors more in error than those which might be arbitrarily assumed.

Similarly, it would seem easy to make large errors in assuming the nature and extent of the storms to be used in design, particularly where a new system is being considered.

Sewer Designs May Be Reviewed

Charles S. Spencer
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School of Public Health, Columbia University
New York, N. Y.

The article on diversion factors for combined sewers, is an interesting approach to storm-overflow design. It is probable that the chief usefulness of the method may be in review of interceptor designs which have been established by the conventional methods.

The Streeter-Phelps formula for oxygen deficiency used in the example shown in Fig. 2 was developed from data on long-term behavior in streams where initial BOD and DO could be determined with considerable dependability. Following heavy precipitation, it is probable that variations in these factors may occur which are not taken into consideration by the formula as applied. Variation in the reaeration constant may be particularly significant. In many cities stream flow will vary

considerably at different outfalls. Stream-flow peaks may not occur simultaneously with sewer peak-flows.

In the example stated, it would be helpful if the authors stated the method of selecting the critical time for maximum oxygen depletion, (t). This factor is not a constant for different streams or for the same stream.

In the numerical determination of "L", shown in the example, it is believed that a typographical error in the sign of the last term has occurred. (*Ed. Note sign should be plus*)—The "L" referred to in the equation should be the total 20-day BOD whereas it appears that the smaller 5-day BOD has been used.

In general, diversion factors smaller than 2.0 should not be recommended for any combined sewer.

It is indicated that the two chief factors influencing diversion to be permitted are capacity of the stream for self purification and cost of the interceptor. In this connection it may be interesting to consider whether relatively larger proportions of the total BOD should not be admitted to the stream at outlets farthest from the treatment plant. This would have the effect of reducing the length of large-diameter interceptors required providing that it did not result in local nuisance. This approach would not be compatible with the diversion factors suggested by the authors based on BOD ratios alone.

Variable Factors Cannot Be Measured

Gordon M. Fair
Dean, Graduate School of Engineering
Harvard University, Cambridge, Mass.

The idea of proportioning discharge of storm overflows to safe load of streams or other receiving waters is by no means novel. The principal new factor in this article is the variation of discharge of different overfalls to suit the needs of the stream. In this connection, the time element between individual overfalls is probably so small as to be relatively of secondary importance in most circumstances. The element of time is in fact glossed over somewhat in the analysis provided by Messrs. Theroux and Meek.

If the problem facing the community were one of protecting bathing beaches or useful aquatic life, some parameter other than biochemical oxygen demand might be the determining one—for example, total bacterial load.

Considering factors which cannot be evaluated closely in such situations and which are so dependent upon hydrological variability, I am forced to the conclusion that the method proposed is an attempt at refinement which is somewhat doubtful in its actual value. This does not say, however, that the broad principle covered by the article is not good.

Constant Sampling Is Required

Charles P. Reming
Executive vice-president,
J. W. Beretta Engineers, Inc.
San Antonio, Texas

This article represents a most reasonable approach to a method of solution to the combined sewer problem. Of course in the area covered by our practice, storm and sanitary sewers are carried generally as separate systems and we do not have this problem in its most critical stage. A city having a combined-sewer system cannot contemplate complete revision of the systems to operate separately and the approach offered seems far more sound than the arbitrary diversion factors used in the past. The use of this method, however, presupposes a constant sampling procedure to determine condition of effluent diverted into a stream and also to determine condition of the stream. The strength of sewage as indicated by its BOD together with the content of sewage with regard to chemical complexity will have to be taken into account in determining various diversion factors.

Characteristics of the stream into which combined storm and sanitary sewage is discharged will necessarily have to be studied to determine rate of oxygen recovery in the stream. The possibility of sludge deposits accumulating in the stream will have to be carefully scouted. Such deposits occurring in eddies during periods of storm flow and high dissolved oxygen content might set up demands above those that could be supplied by oxygen content of the stream during normal flows. Such a condition could result in putrescent deposits producing most undesirable odors during periods of low water.

In other words, the success of the proposed solution to the problem will depend upon adequacy of chemical information obtained during operation of diversion chambers and upon the intelligence with which these chambers are adjusted. Adequate capacity for future growth and increase of sanitary sewage flow must be provided and careful observation intelligently interpreted can result in a greatly improved condition of stream pollution from combined sewer discharges. The great problem not approached by this proposed method of designing diversion chambers is that of adequate treatment or dilution of industrial wastes discharged into water courses.

Extent of Variations Is Needed

Richard Hazen
Malcolm Pirnie Engineers
New York, N. Y.

In their article the authors have used the familiar oxygen sag equation to determine how much combined sewage should be allowed to discharge through overflows into a stream. This approach is obviously more rational than the assumption that a river can handle everything above two or three times the normal flow.

One short-coming in the method is that no consideration is given to factors other than BOD and dissolved oxygen. A low diversion factor established on the basis of oxygen requirements might permit frequent discharge of floating material and solids that could be offensive downstream, or might constitute a health hazard. The minimum diversion factor of 1.5, which the authors recom-

mend, does not provide much leeway.

It is reasonable to believe that there is considerable variation in sewage strength and certainly in the deoxygenation and reaeration constants used in the equation. It would be interesting if the authors could present data showing the extent of the variations found in their studies. Presumably it would not be necessary to use the most extreme values in the design of storm-water overflows.

The statement that "the maximum good is received from each sewer dollar when stream conditions are equalized" is subject to debate. Frequently a community can keep one keep one part of a river much cleaner than another at reasonable cost and the maximum good will depends upon uses to which various sections of the river are put.

Sludge Deposits Exert Oxygen Load

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I have read this article with considerable interest but there are a number of points with which I would disagree.

It is noted that "L" is indicated as the initial biochemical oxygen demand. This is correct, except that it is the initial first-stage BOD rather than the 5-day BOD. While it is not stated, one would infer that the 5-day BOD is meant, and this is only 68 percent of the so-called first-stage BOD.

It is noted that assumptions are made for "K_1" and "K_2". The assumed values might apply to a particular stream but these constants are subject to all manner of variations. It seems to me that the average consulting engineer would be in a much better position to assume a diversion factor intelligently than to assume these constants. As a matter of fact, much work remains to be done on the value of these constants, particularly in small streams. It is my belief that the formula used and devised by Harold W. Streeter some years ago is of principal value in expanding stream results to reflect conditions occurring at times other than when samples were collected. In other words, the first step would be to derive the "Ks" from actual stream results as I do not feel competent to assume the constants with any great degree of intelligence.

It is noted that "t" is taken as two days. This might represent the low point on the oxygen-sag curve on a rather large stream—such as, the Ohio River. There are methods for solving for the minimum point on the sag curve but these are not mentioned in the article.

One of the principal factors in assuming or deriving a diversion factor is the formation of sludge deposits at the outlet which will exert an oxygen load on stream waters long after the storm has passed and minimum flows have returned. Hence, there might be some question as to the fundamental theory behind the whole idea of the article. Certainly it is unfortunate that a diversion factor of 1.2 is found in the illustration selected. Such a low factor would be hard to justify in any design for storm-water overflow.

Double-Overflow Channels Used

Henry W. Taylor
Consulting Engineer
New York, N. Y.

A method of splitting excess flows from a combined sewer to a direct discharge into a river is of course not new. In order to do so with some degree of accuracy a considerable length of double-overflow channel must be provided in the chamber.

On several projects I have often accomplished this by a large iron channel with adjustable side plates that could be set to a determined elevation, the two-lip overflow passing to the stormwater outfall sewer. The chambers are from 10 to 15 ft. long to provide this weir length and a deflector or gate was installed near the middle of the trough to prevent bulking in the latter half.

With reference to the amount of diversion, it may be said that previous practice has been somewhat arbitrary in that interception has attempted to include 2 or 2½ volumes of average dry-weather flow. The proposed method of determining interception to the sewage works is, of course, more accurate and apparently determines a critical point involving both the combined-sewer flow and that of the river. However, I fear that it includes a good many factors about which assumptions would have to be made relating to both runoff from municipal areas and runoff from water sheds.

The article opens up a new angle of approach which, when applied to several cases, would produce a correction in the empirical ratios now used by engineers.

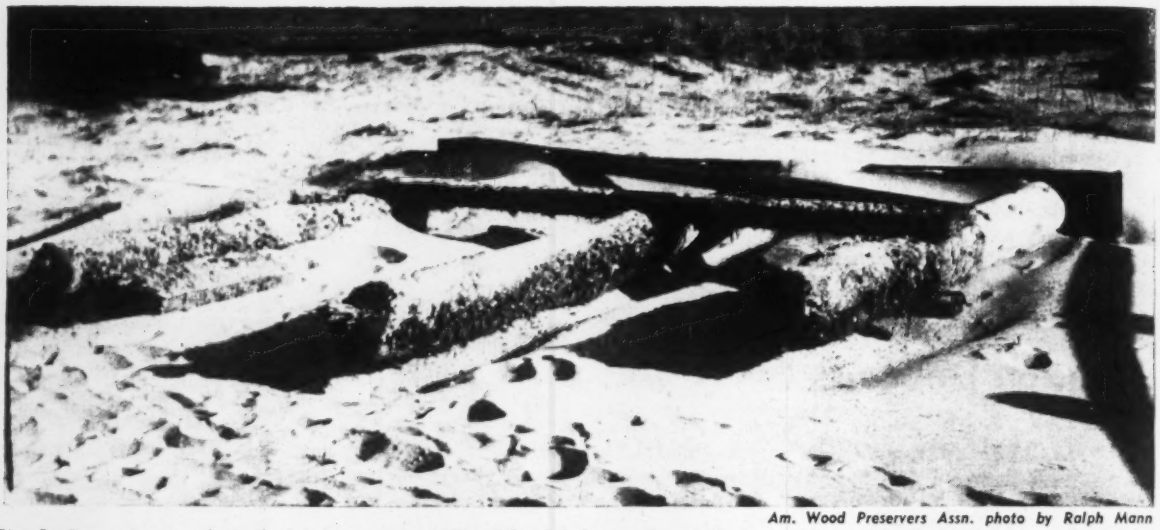
Calculation Versus Measurement

J. C. Stevens
Consulting Engineer
Portland, Ore.

The best comment I can make on the paper is to tell a story of a very meticulous engineer who has passed to his reward. At the time of which I speak he was supervising engineer for the Reclamation Service, as it was called in those days. He had charge of surveys and investigations for setting up reclamation projects. One of his duties was to keep a record of flow of some of the principal streams of the Northwest.

On one investigation, he made a measurement of Columbia River at Pasco, Wash. The bridge piers were protected with heavy riprap and it is doubtful if he could have measured depths within a half a foot correctly. The piers also disturbed the velocity of water very materially so that it was hardly possible that his measurement could have been made within six percent of the actual flow. Yet he calculated the flow to the 1,000th part of the cubic foot per second, the total being over 250,000 cfs.

We should be consistent in all things even in engineering and not calculate with greater refinement than we can measure.



Am. Wood Preservers Assn. photo by Ralph Mann

Fig. 1. Bent of a trestle built for 6 mo. use at Fire Island Inlet on the south shore of Long Island, which was cut by Teredo and floated away after 3 mo. in infested Atlantic waters.

Finding and Fighting Marine Borers

By Robert D. Chellis
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Stone & Webster Engineering Corp.,
Boston, Mass.

Part II Geographic Range and Natural Controls

Contents in Brief—No place in the world seems to be really safe from attack by marine borers. Some waters, some materials, some season, even some cycles of years are less conducive to reproduction and attack by borers but conditions change and damage is done before it is suspected. The first article in this series described destructive borers and how they work. Following articles will cover means of protecting piles from destructive action.

THE GEOGRAPHIC RANGE of marine borers includes the "seven seas." Some species predominate in certain waters and other species are rare. These very waters also may experience a shift in population from the prevailing species to another species. There is not much to indicate that any species is by geographic conditions excluded from any waters. About all that can be told definitely of species range is to name the populations as they have been found.

Beginning with home waters, some eight species of boring mollusks have been found along the North Atlantic coast of the United States. All are capable of destroying wood, and some have been found drilling in soft rock, poor concrete, insulation and rope. The *Pholadidae*, *Petricolidae* and *Lithophagidae* have been reported as rock or concrete borers.

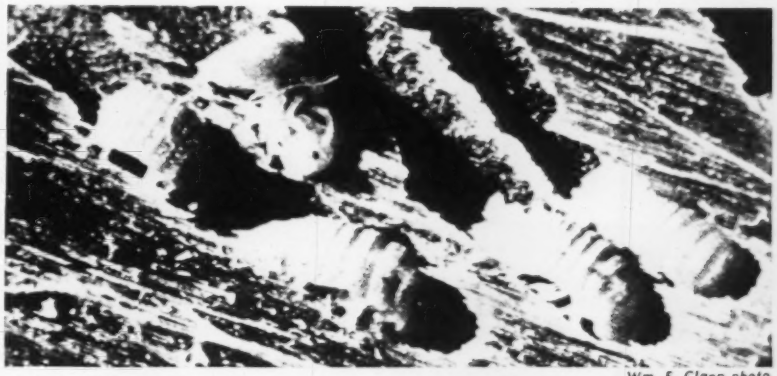
Probably the most destructive of the molluskan borers in northern waters is the common shipworm, *Teredo navalis*, which has been reported in salt water harbors in Europe from North Cape to Italy and the Black Sea, and on the Atlantic and Pacific coasts of North America. Other species of *Teredo* have been found in the Canal Zone, Caribbean Sea and Pacific Ocean. *Teredo parksi* is dominant at Pearl Harbor and other Pacific islands. Other *Teredine* borers in northern regions are *Teredo dilatata*, *norvegica*, *thompsoni*, and *megotara*. *Teredo dilatata* is more damaging than *navalis*, but less common. *Teredine* borers have been found in North American harbors only in salt or brackish waters, although they occur in fresh water in India, Australasia and parts of South America.

Nausitora, a large shipworm, is very damaging in low salinities in tidal reaches of some Australian rivers in which *Teredo* has been unable to exist. *Bankia gouldi*, another and larger type of shipworm, found from New Jersey to the Gulf of Mexico, is even more destructive than *Teredo navalis*. It seems reasonable to expect that the same factors that have caused the recent sudden invasion and survival of *Teredo navalis* north of Cape Cod might result in a similar extension of *Bankia gouldi*.

Bankia setacea, or Northwest shipworm, also known as the Giant or Plumed Pileworm, is one of the most destructive shipworms, and has wide distribution on the Pacific

Univ. of Calif. photo

Fig. 2. Results of Bankia setacea attack on five-months old piles in mole at Oakland, Calif.



Wm. F. Clapp photo

Fig. 3. Section of pile showing live Limnoria lignorum at work.

Coast and in Alaska. It has been very destructive on the northern Pacific Coast, attacking creosoted piles through knot holes and damaged spots. *Xylophaga dorsalis* has caused severe damage in Europe, but to date has appeared only in the deeper waters of harbors on the New England coast.

Of the molluskan or clam-like forms, the *Martesia striata* has been active in Hawaii, the Philippines, Gulf of Mexico, Florida, Cuba and Puerto Rico. While not working as fast as the shipworm, it is able to destroy a pile in two years. *Hiata* has been active in Florida. *Pholadidae* are widespread, and their ability to bore quite hard rock is interesting. They have not done a great deal of damage to sound concrete containing hard rock aggregate. Over half the concrete-jacketed piles in San Francisco in 1922 were attacked, one-fifth badly, but the concrete was generally cement mortar poured around the pile in forms after driving, and would be considered poor by present standard, although some was quite hard. Shipworms have penetrated through *Pholas* holes in casings, causing considerable damage. Most damage was caused by the edible *Pholadidae penita*, known as the rock clam. Other species present were *Platyodon cancellata* in very poor mortar, and *Petricola carditoides* known as the nestler, which were probably inhabiting burrows made by other species.

Several kinds of boring Crustacea are reported to be destructive in the North Atlantic region, among these being *Limnoria lignorum* and *Chelura terebrans*.

Limnoria may be found in all salt or brackish waters of any temperature, polluted or clean. It abounds in English waters up to the Arctic circle, and has been found in Alaskan waters as far north as Kodiak Island, in Puget Sound, in the Black Sea, Baltic Sea, South Africa, New Zealand, Australia, Japan and the Falkland Islands, among other places.

Chelura terebrans has been reported as a wood destroyer from Norway to the Black Sea, Cape of Good Hope and New Zealand, and recently has infested the Atlantic coast from Florida to Labrador, apparently driving out the original *Limnoria* in some instances. *Chelura insulae* occurs in Samoa and Hawaii.

It was formerly considered that *Chelura* was much more destructive than *Limnoria*, and that if it continued to spread and increase, it would become a major problem to owners of marine properties on the east coast of the United States. Australian scientists seem to have proved that *Chelura* has been greatly over-rated. Both *Limnoria* and *Chelura* work so rapidly that few other forms of marine life can maintain a hold on the same surface.

Sphaeroma is most common in tropical waters, from Florida to Brazil, in South Africa, India, Ceylon, New Zealand and Australia, but appears occasionally in temperate waters. It is very destructive, and is able to adapt itself to low salinity. *Sphaeroma pentodom* is known to occur on the Pacific coast to Alaska. *Sphaeroma destructor* requires brackish to almost fresh water, and has made severe attacks in St. Johns River in Florida. *Sphaeroma tere-*

Am. Wood Preservers Assn. photo

Fig. 4. Remnant of untreated pile from Boston harbor; note stubs of hard knot wood by-passed by the borers.

brans is very destructive in Queensland.

The distribution of marine borers is constantly changing. New infestations frequently occur when the environment is favorable. The previous absence of borers is no assurance that protective measures can be omitted with safety. In Newfoundland, Nova Scotia and New Brunswick, during 1937, the attack of *Limnoria* increased two to ten times over previous years. In 200 locations in New England waters, *Limnoria* showed an almost unbelievable increase though serious attacks on piers in Boston harbor occured years earlier.

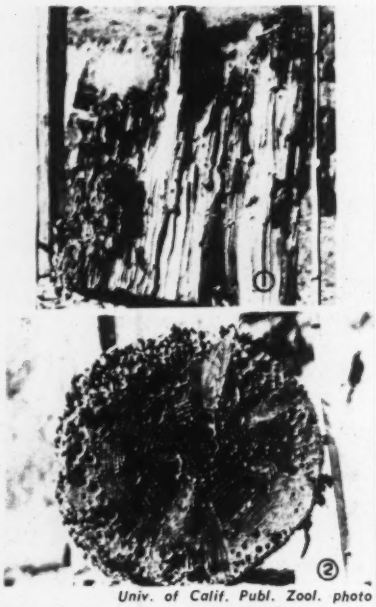
Teredo navalis had been considered the most destructive borer in New England waters prior to 1936, but its activities were almost entirely south of Cape Cod. In 1937 a great increase in teredine activity was noted in southern New England waters, and *Teredo* appeared in destructive numbers in northern New England waters known to have been previously immune. Also, *Teredo tryoni* and *Teredo dilatata*, never previously recorded in New England harbors, caused considerable damage.

Both *Teredo* and *Limnoria* increased to large numbers along the North Atlantic Coast in 1939, 1940 and 1941 as indicated by records at New York, Portland, Me. and Liverpool, N. S. During the 1940 peak there were 100 times as many borers of both species as there were a few years earlier. *Limnoria* still were decreasing rapidly in 1945. *Teredo* nearly disappeared in 1943 but were again increasing rapidly in 1945.

Infestation may be due to importing borers in infested shipping or driftwood. Changes in food supply, natural environment and cyclical changes may create conditions favorable to attack. Removal of old untreated timber marine structures, and prevention of the use of harbors as dumping grounds for wood waste are two measures advocated to reduce the borer population.

Environmental influences

Salinity, temperature, current action, depth of water, pollution, hydrogen-ion values, dissolved oxygen and sulphuretted hydrogen all have great bearing on the presence, or possible presence, of borers. A variety of such combinations may occur in any one harbor, and wide variations in severity and nature of attack may occur.



Univ. of Calif. Publ. Zool. photo

Fig. 5. Example of multiple attack. Note large tubes of Bankia and smaller ones of Teredo, with erosion by Limnoria at breaking point. Sphaeroma also present. Section cut 1 ft. above break on dolphin pile driven Dec. 1917, removed July 1920 at Richmond, Calif.

Salinity is an important factor. Salt or brackish water is required by most borers. Changes in salinity may retard or kill borers, a variation of only 10 parts per thousand having a marked effect. Salinity may vary at different depths. Ocean salinity is about 30 to 35 parts of salt per 1,000, and the danger point is usually reached at 15 parts. *Limnoria* and *Bankia* usually require 20 parts. *Limnoria* are killed in 24 hours by 6.5 parts. In freshets colonies may be exterminated. *Teredo* activity decreases in salinities of less than 9 parts per 1,000. However, by plugging the entrance to the burrow with its pallets it can greatly defer the effect of fresh water. Six weeks at below 4 parts seems needed to kill.

Bankia setacea is much less resistant than *Teredo* to low and changing salinities. *Bankia gouldi* thrives in salinity as low as 7 parts per 1,000. *Nausitora* prefers low salinity in Australian waters and is adversely affected by a rise. Some species occur in tropical fresh waters.

Water temperature has considerable bearing on activity, and in some places attacks can occur only during a few months. Temperature effect is much reduced after the borers have entered the wood. In northern waters the period of attack is limited, generally, to little over two months, although the borers continue to burrow after they enter, unless the water temperature falls to just above freezing, when they lie dormant.

Borers have definite breeding seasons, but this varies among species, so that attack may be nearly continuous. *Limnoria* adults, which are free to move from place to place, seem able to breed throughout the year when temperature and salinity are favorable. *Teredo* and *Bankia* destroy wood after the breeding season when the borers grow to maturity. *Teredo navalis* breeds in late summer or early fall. *Bankia setacea* breeds from February to July in San Francisco bay. Temperature seems to govern, the borers liking cold water, and the breeding season in Alaska starts at the first of the year. *Teredo navalis*, at least, has shown marked cylic intensity at 19, 30 and 70 year periods.

Removal of pollution from sewage, mill wastes, catch basin overflow and oil, has been known to be accompanied by a marked increase in borer activity. Industrial wastes and catch basin overflows appear to deter borers more than does sewage. *Limnoria* appears to have no scruples regarding sewage. Invasions of certain harbors by borers as a result of pollution prevention programs may be expected, and owners should prepare protective measures to avoid damage.

Oxygen in the water is necessary for respiration of borers. More than a tiny amount of hydrogen sulphide is fatal. Normal sea water has a pH value of 7.5 to 8.5 and any marked change is fatal to borers. (A value lower than 7.0 on the acid side is usually an indication of industrial waste or heavy pollution.) Heavy silt is a great aid in limiting *Limnoria*. It is said that *Teredo* cannot thrive in muddy or turbid waters.

The pest of marine borers and its prevalence as described indicate the exclusion of any practical resort other than artificial protection. This has been undertaken, with various degrees of success, all through the centuries. A description and appraisal follows in succeeding issues, considering first metal armoring and concrete encasement.

Open-Web Girders Simplify Air-Conditioning Duct Location

HEADROOM was saved in Macy's-Jamaica, a department store recently built in Jamaica, L. I., by passing air-conditioning ducts through the steel roof girders, which support a roof-top parking field.

The building is 196 ft. wide by 275 ft. long and contains a sub-basement, lower-level sales floor, street floor, balcony, roof parking area, and penthouse. The distance between the lower-level sales floor and the street floor is 15.5 ft., and between the street floor and the roof 24 ft. Selling space occupies 91,000 sq. ft. of the 157,500-sq. ft. total.

Faced with limestone and bronze trim, the store has a structural steel frame with typical bays about 33x61 ft. Floors are 4-in. thick "gritcrete", topped with terrazzo or carpeting.

Multi-layer roof supports car loads

The main roof is graded to drain by varying the thickness of a layer of cinder concrete from 0 to 2 in. Below this layer is ½ in. of mortar, tar and felt roofing, another ½ in. of mortar, 4 in. of vermiculite concrete insulation and a 4 in. reinforced concrete slab. Above the cinder concrete fill is ½ in. of mortar and a final coat of 2-in. thick asphaltic concrete.

To ease the local traffic problem, customers may park their cars on the store roof (Fig. 1). Parking space for about 150 automobiles is available in 40,000 sq. ft. of roof. Access is provided by two one-way ramps inside the building.

Another provision for relieving traffic congestion in the area is the installation of a receiving dock in the sub-basement. Trucks will be taken into the building to eliminate delivery operations on the street level and are lowered to the sub-basement by means of a heavy-duty elevator.

Stockrooms are conveniently located adjacent to sales departments. These selling areas are characterized by an openness of space, achieved by use of large bays and elimination of partitions. Lighting used there is a combination of fluorescent and incandescent.

Fig. 1. Roof-top parking of customers' cars is provided by a department store.

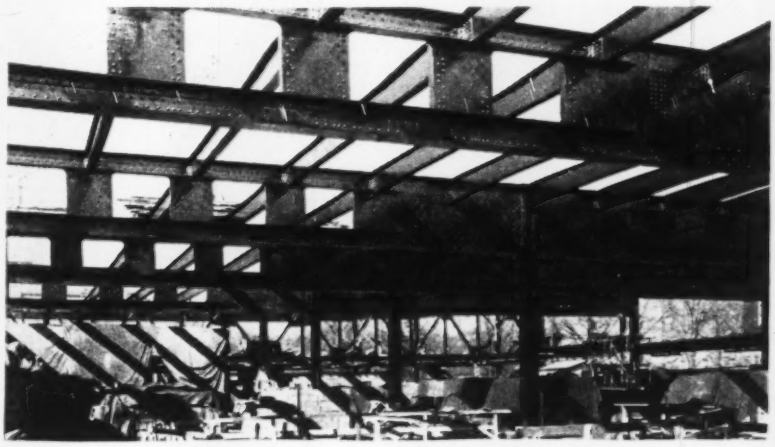


Fig. 2. Roof girders with openings in the web for air-conditioning ducts have the appearance of Vierendeel trusses.

Duct openings cut in girders

The store is fully air conditioned by means of equipment located in the sub-basement and the penthouse. An interesting feature is that air from the penthouse is fed through ducts that are passed through the webs of the roof girders between floor beams, thus giving these girders somewhat the appearance of a Vierendeel truss.

A typical girder is 74 in. deep and consists of two 18-in. deep T-flanges and two web plates 69 x ⅜ in. Spanning about 61 ft., these girders support 21-in. wide-flange roof beams spaced about 7 ft. 7 in. apart. Openings are 4 ft. 4 in. wide by 3 ft. 4½ in. high, and are framed by continuous horizontal angles on one side of the web and by vertical angles on the other.

Another unique structural feature found in this building is a 40-ton plate girder. This member provides a clear opening at the store entrance of about 103 ft. It is composed of 8 x 8 x 1⅛-in. flange angles and an 89 x ½-in. web plate, with the total depth at mid-span increased by the addition of cover plates to about 94 in. Slots 9 in. wide by 1½ in. high are provided in the lower part of the web to permit the tie plates of the cantilevered canopy beams to pass through.

Architects are Robert D. Kohn, and John J. Knight & Ferdinand Klebold, Associates, with Richard B. Belcher, consultant. Weiskopf and Pickworth are structural engineers, and Vermilya-Brown Co. general contractors.

French Research Program Will Use Test Tunnel of Prestressed Concrete

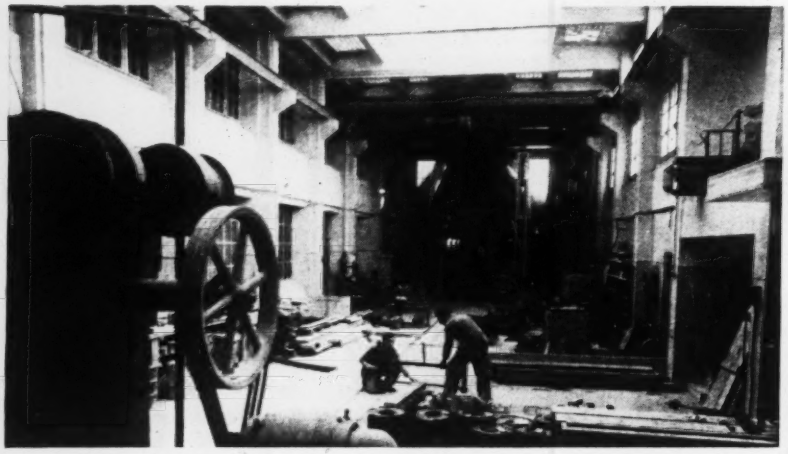


Fig. 1. Hall for large-scale tests in Laboratories du Batinent et des Travaux Publics in Paris. Test tunnel is in background.

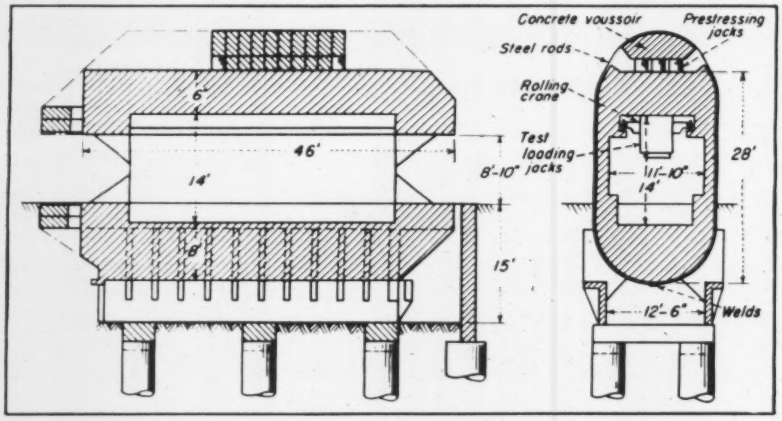


Fig. 2. Concrete test tunnel in which structural members are loaded by jacks reacting against ceiling. Concrete was prestressed during constructions by other jacks stretching a yoke of steel rods encircling the tunnel.

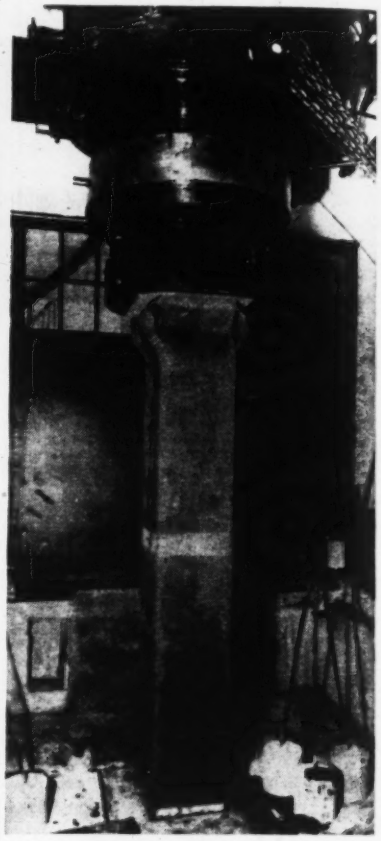


Fig. 4. Testing a steel column under a load from the 2,000-ton jack, which is positioned by a rolling crane.

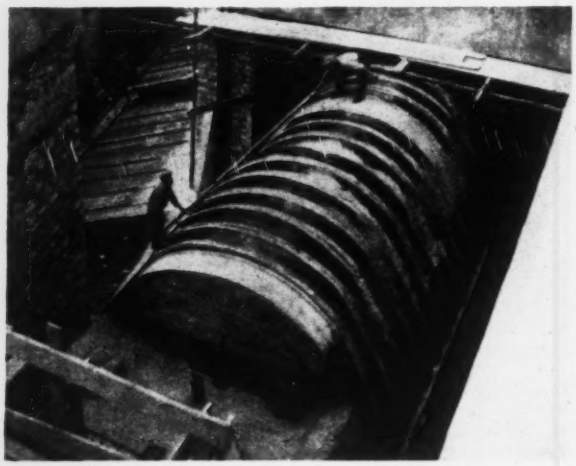


Fig. 3. Prestressing the concrete by jacks set in the roof of the tunnel and reacting through a voussoir on yokes of steel rods. Space occupied by jacks was later filled with concrete.

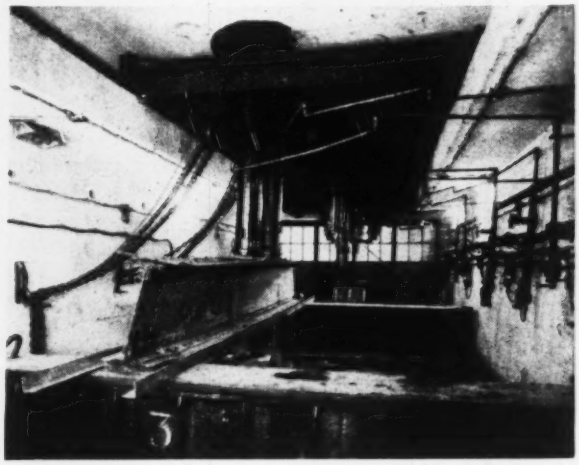


Fig. 5. Setup for a test of a steel beam under two loads from the 100-ton jacks. Note the hydraulic control piping and, in the background, the 2,000-ton jack for larger tests.

New Cooperative Research Setup To Aid Reconstruction in France

(McGraw-Hill World News)

SOMETHING NEW in the field of industry-government-user cooperation to improve construction techniques got under way in France in the last days of 1947. A new organization was created to coordinate the work of existing research laboratories in fields relating to construction, and to bring it down to earth by having users and contractors join in deciding what problems have to be tackled.

The new grouping is known as the "Centre Scientifique et Technique du Batiment." Sponsors of the new center include the Minister of Reconstruction, the High Commissioner for Planning, the president of the architects' order, the president of the national building trades association, and the head of the building workers' union. Its head is Andre Marini, director of technical studies in the Reconstruction Ministry.

M. Marini emphasizes that the center will coordinate rather than supplant existing laboratories. It will pay them to make specific studies, decided on by its specialized committees grouping representatives of the construction buyers, builders and researchers. The buyers—principally the Reconstruction Ministry, the railways, the mines and other industries planning workers' housing projects—will put up the money. The Reconstruction Ministry has already advanced $1,250,000 toward the center's first year of operation.

"We don't want to order the industry around", says M. Marini. "We plan to set up new standards, with the cooperation of all concerned. We hope to help spread the use of new materials and methods among progressive builders."

Among the laboratories already functioning, a leading place is occupied by the "Laboratories du Batiment et des Travaux Publics" inaugurated in 1935 by the trade associations of housing and public works contractors, and of the plumbing, heating, paint and glass industries.

This central laboratory, employing 130 people and with 45,500 sq. ft. of floor area, combines both testing and research units in soil mechanics, building materials, structures, and physical, mechanical and chemical studies. In addition, branch laboratories have been established in Algiers, Casablanca, and Dakar. Six field test units have been established in French provincial cities, and seven more are planned.

About 50 percent of the laboratory's funds come from fees for testing work on products, processes, or scale models of new projects. The remaining half of the $850,000 annual budget— the part devoted to research —is furnished by building and public works contractors. This money is raised by a voluntary tax on the payrolls of the industries concerned. Builders pay in 0.1 percent of their payrolls to their trade association for this purpose; and public works employers pay in 0.15 percent similarly to their association.

Thus, although its test results are legally recognized by government ministries and courts, this laboratory has been built up and supported chiefly by private initiative. Its director is Robert L'Hermite.

In its modern brick building the laboratory has assembled a wide variety of testing equipment, including a number of machines developed on the spot. Most striking piece of equipment is a pre-stressed concrete tunnel, which houses a 2,000-ton jack and four 100-ton jacks for use in load-testing girders, columns and other members. Slightly over 11 ft. square, the tunnel is 46 ft. long. Resting on six piers and weighing 700 tons, it consists essentially of two elliptical half-cylinders, the bottom attached to the piers by a series of thin tympanums spaced one meter apart resting on two lateral beams.

The tunnel's concrete, after setting, was compressed under a pressure of 178 psi, both vertically and horizontally, by a series of steel rings. Final compression vertically totalled 10,000 tons and horizontally 2,500 tons.

Vertical compression was effected by 20 groups of sixty-four 0.4 in. high-tensile steel rods encircling the tunnel. At the top, each band of rods was run over a concrete voussoir. Under the voussoir (see Fig. 3) three jacks were placed, and the two outside ones extended to exert a total of 600 tons of pressure. The two outer jacks maintained this pressure while the inner one was removed and replaced with concrete. After removal of all jacks and filling the remaining space with concrete, from 50 to 100 tons of the prestress was estimated lost due to shrinkage and compression of the concrete; but each of the 20 steel bands still exerted 500 tons of compression. Horizontally, five sets of bands were similarly mounted.

Inside the tunnel, the 2,000-ton jack and the four 100-ton jacks are suspended from overhead travelling cranes. (See the accompanying illustrations.) The tops of the jacks, when in use, react directly on the ceiling, in principle merely releasing the tunnel's concrete structure from some of the pressure exerted by the steel bands encircling it. The tunnel has functioned satisfactorily since 1935.

Among other machines developed by M. L'Hermite and his associates are an apparatus to induce and measure effort by movement of a weighted pendulum, a new machine for measuring fatigue in steel, plastic and plywood sheets, and electronic equipment for measuring elasticity changes in metal rods.

M. L'Hermite considers his laboratory as the "doctor of building". Since the war a number of new building materials have appeared in France to meet the needs of reconstruction, some of them developed locally, some imported from us or the British. This laboratory tests all of these, and such tests of new materials constitute about 30 percent of its testing work.

In the research field M. L'Hermite indicates work is under way on piles; crushing of rocks; the influence of work-hardening on the spatial elastic properties of metals; concrete roof shells; shrinkage of concretes and cements; the elastic and plastic deformation of concretes and cements; gluing and impregnation of building stone; new building glues to join steel and concrete, stone and concrete, plaster and steel, etc.

Stadium Roof Features Concrete Cantilever

Contents in Brief—The main grandstands of a new football stadium in Seattle, Wash., are protected by a concrete roof which has a cantilever overhang of some 40 ft. The roof, flat on the underside, is supported from above by a system that combines vertical ribs and a large box girder.

SUPPORT for a reinforced concrete grandstand roof recently constructed in Seattle, Wash., is provided by a system that includes a large box girder and many concrete ribs. With the exception of the rear wall and thin columns spaced 79 ft. apart, all of the supporting structure for the roof slab is on the upper side. Thus, maximum visibility for the spectator is provided and excellent architectural effect is achieved.

Although admittedly more expensive than a steel or wood structure, especially in the Northwest area, where wood is presumably less expensive, this concrete structure has the advantage of low maintenance cost and of being fireproof. Bearing the title "Seattle High School Memorial Stadium," it is being used for high school football games and other civic functions.

As built, the stadium consists of a concrete grandstand seating 5,500 on each side of the field. Each stand is covered by an identical concrete roof, which is 236 ft. at the front edge and 108 ft. 8 in. deep. Completion of the horseshoe stadium by building stands around one end zone will increase the seating capacity to a total of 26,000. The end zone stands will probably not be covered for some time in the future. Also included in the program is a field house that can accommodate four football teams at one time for locker, shower, and training facilities.

In plan, the stadium roof is concave toward the field, the front dimension being 236 ft. $3\frac{3}{4}$ in. and the back being 268 ft. $9\frac{3}{8}$ in. The radial depth of the roof is 108 ft. 8 in. Of this depth, 40 ft. $5\frac{1}{2}$ in. is cantilevered out from the columns and 68 ft. $2\frac{1}{2}$ in. is supported between the columns and the rear wall. Columns are spaced about 79 ft. on centers and the rear wall is continuous.

Box girder is 8x6 ft.

Support for the $3\frac{1}{2}$-in. thick roof slab is provided in the long direction of the roof by a box girder 8 ft. high and 6 ft. wide (outside dimensions) which extends along the line of the columns. Walls of this box girder are 12 in. thick with appropriate chamfers at the corners. The wall thicknesses increase near the columns by 3-in. steps each 12 ft., until a 1-ft. 6-in. thickness is reached. At the column, a solid block of concrete some 6 ft. long is cast to cover the reinforcing required to transfer loads to the columns from the box girder.

Ribs 8 in. thick running completely across the roof from the back to the front are spaced about 12 ft. apart at the box girder. These ribs are 3 ft. high at the back wall, 1 ft. at the front end, and 8 ft. at the box girder. They extend completely through the box girder, providing webs inside the box every 12 ft.

The roof is sloped toward the back at a grade of some 3 percent. Drainage is provided at the box girder and at the rear wall so that water will not accumulate on the roof. An asphaltic type roofing material will be placed on top of the concrete to further protect it from weather.

One reason for the extreme amount of reinforcing at the top of the columns is the high earthquake stress assumed. This horizontal force was assumed to be 15 percent of total

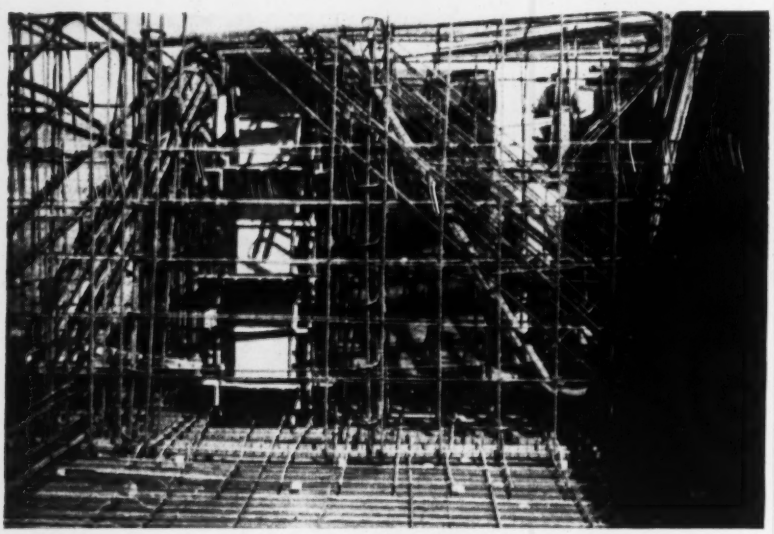


Fig. 1. Around this maze of reinforcing bars was cast a solid mass of concrete. This served to tie the columns into the box girder on the roof of the Seattle grandstand.

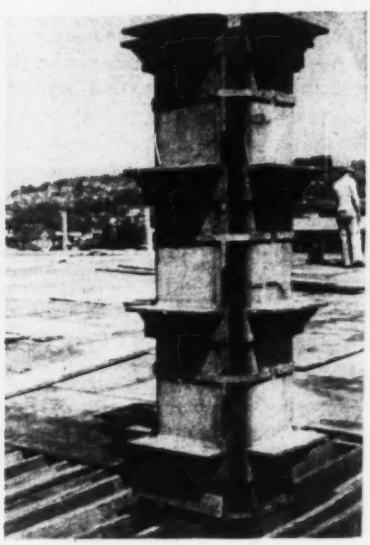


Fig. 2. Columns were made of two wide flange beams.

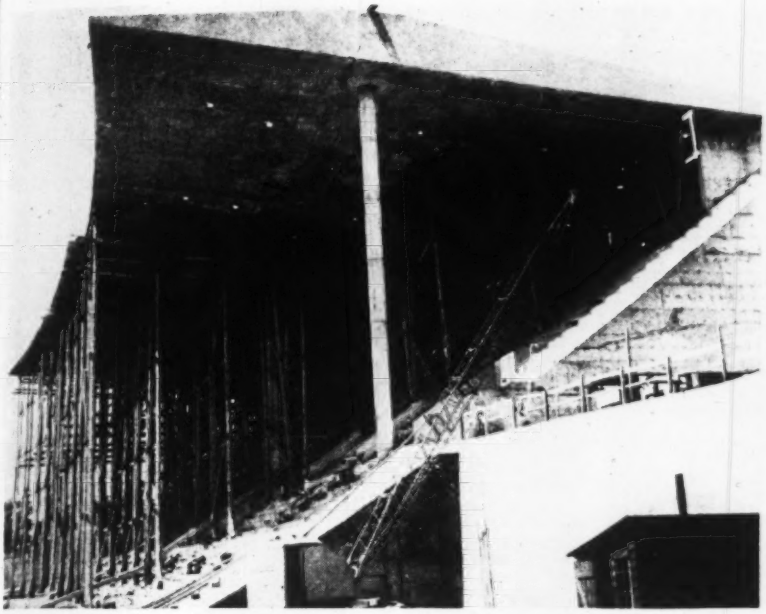


Fig. 3. One of the all-concrete grandstands and roof is shown here during construction. The lip of the roof is some 67 ft. above the stands.

loads. Vertical loads used for design purposes included live loads of 25 psf. and a roofing load of 6 psf. Dead load was also included in the earthquake stress.

As it was desired to make the columns equally resistant to bending in all directions, they are made of two 21-in. wide flange 132-lb. sections. One of the sections is split down the middle and welded at right angles to the other. To provide further resistance to bending, cover plates 8 in. wide and $\frac{1}{2}$ in. thick were welded on the flanges for a good portion of the unsupported length of some 42 ft. 7 in. where the bending moment is greatest.

To bond the top of the columns into the concrete of the box girder, four 6x6x$\frac{3}{8}$-in. angles on 2-ft. centers were welded to each flange. Three stiffeners, each $\frac{1}{2}$ in. thick, were welded to each angle.

Ties consisting of 1-in. by $\frac{3}{8}$-in. flat bars were welded in pairs on 12-in. centers for the entire length of the column. The column extends to within 1 ft. of the top of the box girder.

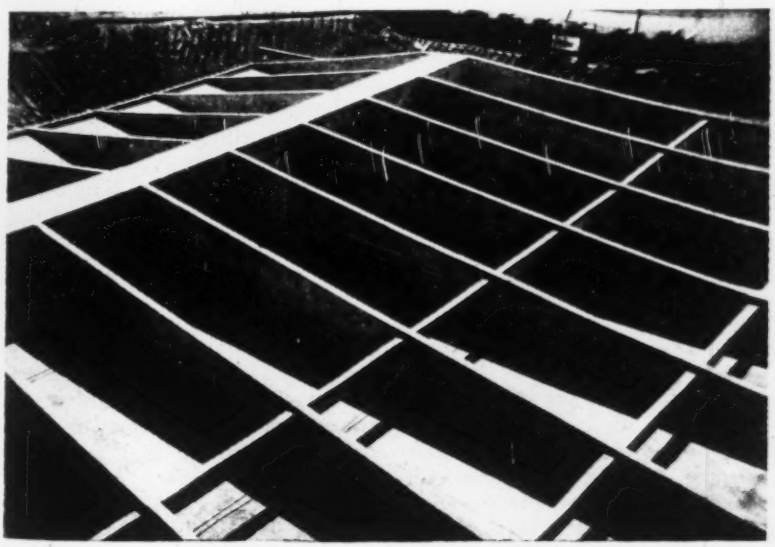


Fig. 4. The large box girder and the vertical ribs of reinforced concrete that support the roof are located on top of the slab.

Major problem in construction involved the falsework support of the roof slab. For this purpose, the contractor used timber bents in rows 20 ft. apart with the timbers (poles 10 in. dia. and larger) in each bent 17 ft. apart. Because the grandstand slabs were only $2\frac{1}{2}$ in. thick, the bents were arranged so they were directly over the columns supporting the stands. Thus, the load was transmitted directly to the footings and was not supported by the stands.

The number of timbers supporting the roof during construction was such that only $\frac{1}{2}$-in. settlement was expected according to preconstruction calculations. These calculations were borne out by results voted during construction.

Old sewer under foundation

An existing brick sewer under one grandstand presented unusual foundation difficulties. Located in what had been a street, this 24x30-in. oval sewer passed underneath the footing site for two major columns. The backfill over the sewer had not been thoroughly consolidated and it was possible that at some future date the sewer would be excavated for repairs. Accordingly, instead of the usual spread footing, the columns were supported on beams that spanned the width of the probable future excavation. On each side of this width, the beams were carried by mat footings.

These footings were $25\frac{1}{2}$ ft. on center, this distance being based on the invert depth (17 ft. below grade) and the nature of the soil (clay with the angle of repose under load being 45 deg.) As the columns are off the center of the beams, the footings are not of the same size, one being $9\frac{1}{2}$x12x3 ft. and the other $9\frac{1}{2}$x17x5 ft. The concrete beam between the two footings is $8\frac{1}{4}$ ft. deep, 5 ft. wide and 35 ft. long.

The stadium and other facilities were designed for the Seattle School District No. 1 by George Wellington Stoddard & Associates, architects, Seattle. George Runciman, structural engineer, Seattle, conceived the structural design and Peter Hostmark, structural engineer, Seattle, worked out the details. General contractor on a cost-plus basis was Puget Sound Bridge & Dredging Co.

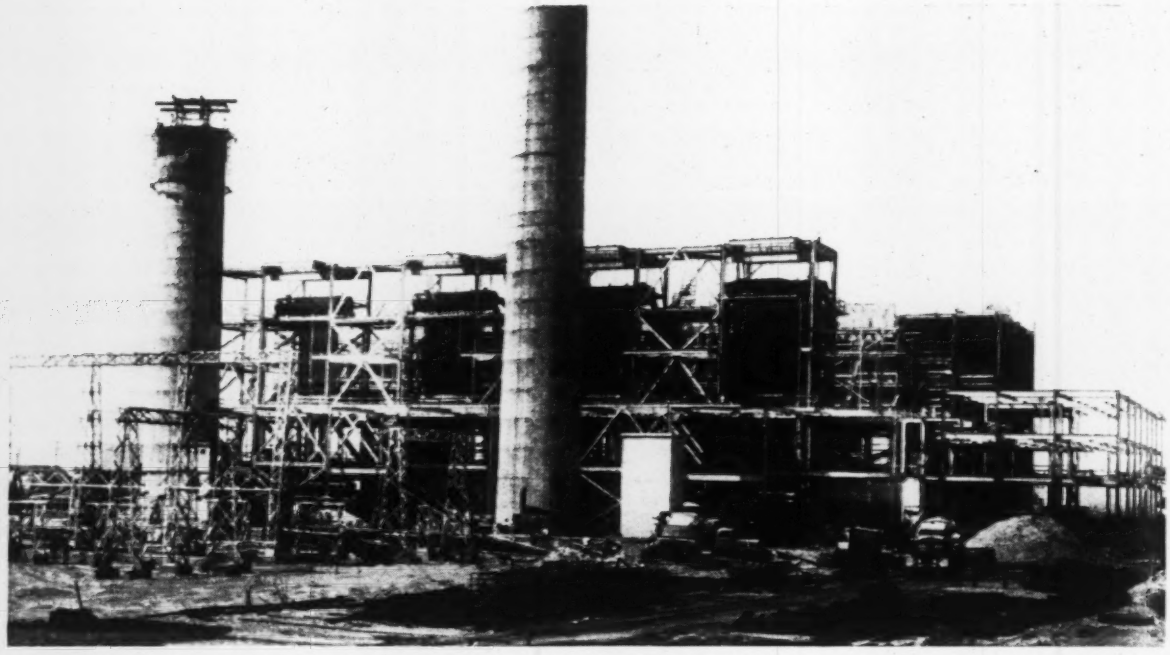


Fig. 1. Built near an earthquake fault the Redondo Beach, Calif., electric plant is designed to resist seismic forces.

Structural Design for A Steam Plant In an Earthquake Area

R. A. Larsen **W. F. Swiger**

Engineers, Structural Division
Stone & Webster Engineering Corp.
Boston, Massachusetts

***Contents in Brief**—Foundations are tied together and the steel and concrete frame of the superstructure made integral to resist seismic disturbance of the order of 0.2g for a 240,000-kw. steam-power plant near Los Angeles. Heavy load concentrations in boilers and accessories, suspended some 100 ft. above the ground, required ingenious connections to permit thermal expansion and yet prevent structural movement.*

A 240,000-kw. four-unit steam-generating plant near Los Angeles is designed to assure uninterrupted power despite probable seismic disturbance from a major fault as close as four miles. Piles driven into firm sand support separate foundation piers, which are tied together by reinforced concrete struts. The superstructure is heavily braced, both longitudinally and transversly, to resist stresses from possible earthquakes. Special attention is given to support of the steam-producing units, which are hung from the frame high above the foundation.

The new plant, the Redondo Steam Station of the Southern California Edison Co., replaces an abandoned steam plant built in 1907 at Redondo Beach, southwest from Los Angeles.

Installation of the first two 60,000-kw. turbine generators, served by four boilers, is nearing completion with the units scheduled to be in operation next spring. Two additional 60,000-kw. turbines and three additional boilers have been ordered with field installation for 1948. Each of the boilers is capable of producing 400,000 lb. of steam per hour continuously at 850 psi. and superheated to 900 deg. F. It will be an oil-burning plant and two storage tanks are provided for in the design. However, provision has been made for burning gas when available. Space is provided for future bunkers, pulverizers and coal-handling facilities so the plant can be converted to use coal if that becomes economical.

Principal objectives in the design and layout of the plant were to achieve maximum economy in construction consistent with maximum efficiency in operation. A semi-outdoors installation was adopted with enclosed firing aisle and outdoor boilers.

The plant is designed with a steel

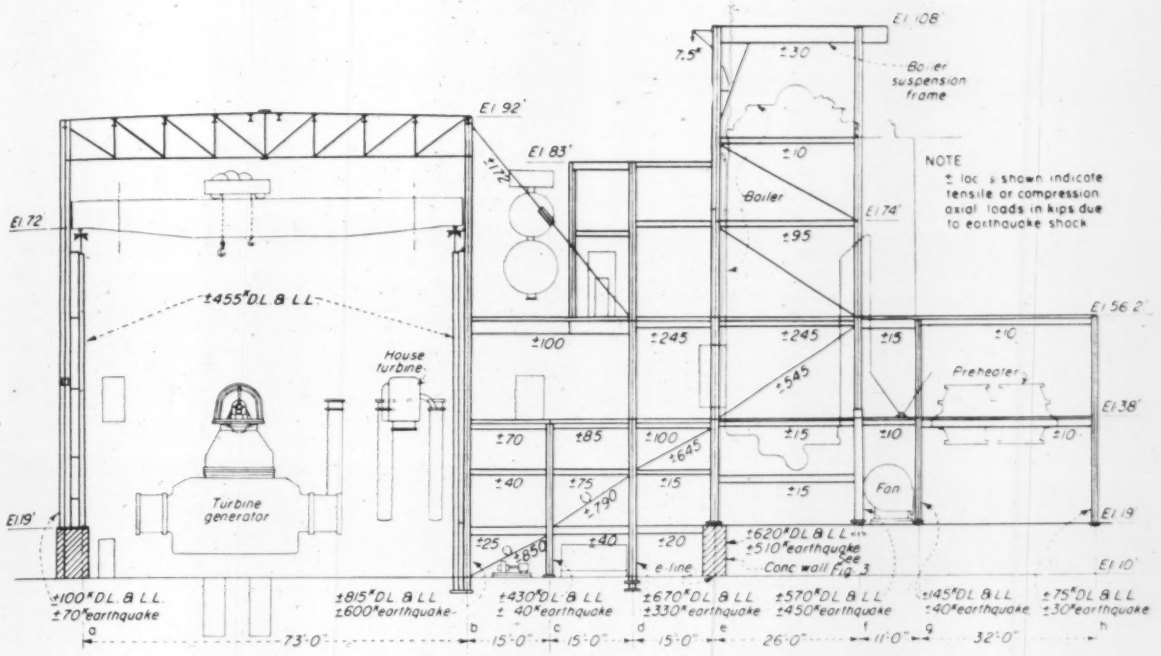


Fig. 2. Stresses in transverse structural frame from seismic movement computed at 0.2g are shown on this drawing. For details of the connections between footings for column lines c and f, see Fig. 3.

frame and walls of reinforced concrete; exterior finish is of architectural concrete; interior finish is concrete with red granolithic floors in the turbine room. The entire structural frame is riveted except for certain of the seismic connections immediately above the base plates of the columns where welded construction is used to reduce gusset plate sizes.

The entire Los Angeles area is considered seismically active and subject to damaging earthquake shocks. The plant location is about four miles north of the fault system encircling the Palos Verdes Hills and some seven miles west of the Inglewood fault system along which the damaging earthquakes of Inglewood in 1920, Long Beach in 1933 and Gardena in 1941 were epicentered.

It is essential that central power stations continue in operation during periods of emergency following an earthquake. Location of this plant in an area of seismic activity upon recent deep alluviums indicated that care should be taken to provide adequate protection against earthquake. Because of its location, it was anticipated that in the event of a severe shock relatively slow, large amplitude waves would probably develop in the earth. Past experience has shown that under such conditions rigid, monolithic structures survive best.

Accordingly, for the design of this station a seismic coefficient of 0.2g was used based upon the total weight of structure and equipment. The turbine supports were designed for a seismic coefficient of 0.2g including weight of support, turbine, generator, condenser and other equipment. Connections and members were investigated against reversals of stress resulting from shocks.

The plant is being built on a sandy beach of the Pacific Ocean adjacent to Hermosa Boulevard and about 650 ft. from the shores of the ocean. Borings made over the area of the site show that underlying the recent beach sands of the Pacific, which extend down to about El. —7 (mean low water is 0.0) are 6 to 10 ft. of interbedded organic clays, peats and diatomaceous earths. These fine grained organic soils were shown by tests on undisturbed samples to be compressible and therefore unsatisfactory for the support of the proposed station. Underlying them and extending downward to the depths of the borings, El. —130, are medium to fine sands, which have been identified as Marine Terrace deposits.

It was essential that the foundations of the proposed station be carried through the compressible cohesive strata and into the underlying sands, requiring piles some 30 to 40 ft. long for friction bearing of about 35 tons per pile—allowing for some reduction in capacities due to group

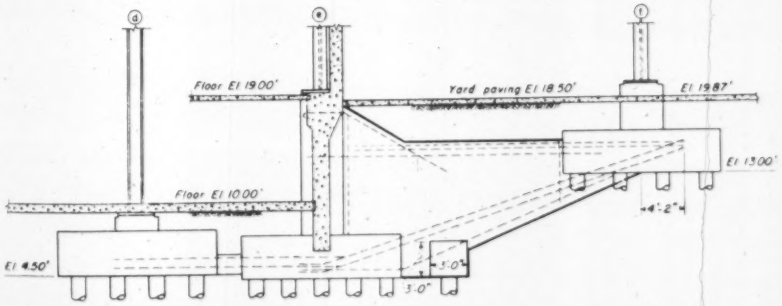


Fig. 3. Where depth of foundations changed at a line of principal stress a heavily reinforced beam was used, as between footings for column lines c and f.

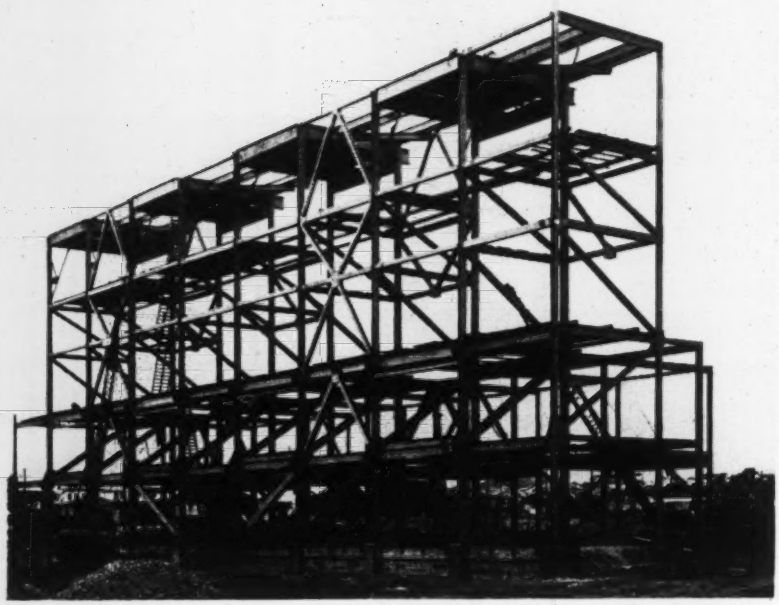


Fig. 4. Heavy diagonal bracing is used to stiffen frame for top suspension of boilers.

action. Studies of comparative economy showed cast-in-place concrete piles to be the economical method of supporting the plant.

Some 2,300 piles were required, driven to a specified resistance in the load-bearing sand strata. To insure that none of the driving resistance would develop from temporary support in the upper sands or peat strata, upper soils were jetted during driving.

While it is customary practice to design earthquake structures as if they were subjected to lateral loads upon the superstructure and then transmit these loads to the foundation, in actual fact earthquake shocks originate within the earth and are transmitted to structures through their contact with the ground as sudden accelerations. Large stresses are thus set up within the structure, because of its inertia. Accordingly, special attention was given to design of the foundation and external walls below the ground level.

To insure the entire foundation acting as a monolithic unit, all pile caps, including the turbine foundation mats, were rigidly interconnected by heavily reinforced concrete struts. External walls below grade were designed as retaining walls for forces far in excess of the usual active pressure, since earth movements under quake conditions may develop heavy pressures on these walls.

At the e line of columns (Fig. 2) where the pile caps step down to turbine room grade, a special problem existed because of forces exerted on the wall between columns along the e line, which acts as a retaining wall, and the forces to be delivered between the pile caps on the e and f lines. The design developed, Fig. 3, is a series of vertical walls extending from the e to the f lines, which act as rigid ties between pile caps at different levels. These transmit the forces developed without throwing moment into the pile caps or columns. Piles are reinforced for their entire length to resist earth pressures and to protect them against differential wave motions in soil strata through which they pass.

Seismic design of the superstructure frame involves two separate bracing systems—one longitudinally and one transversely across the station. Principal seismic bracing is the reinforced concrete exterior walls and a system of diagonal members located in the steel framing system. The loads of earthquake induced forces are transmitted through these bracing systems to the pile caps.

Along the e line, these forces are transmitted to the reinforced concrete wall that, acting in shear, transmits them to the pile caps. Longitudinally the outside wall of the turbine room, which contains a series of high window openings, acts as a rigid frame structure transmitting earthquake forces to the pile caps.

Transversely seismic loads are transmitted through a system of diagonal bracing in the steel frame to the pile caps. In this direction the plane of the outside wall of the turbine room is perpendicular to the earthquake forces and is designed as a series of vertical beams with variable moments of inertia at the columns with wall panels spanning horizontally. The reaction at the top is taken through the roof slab and top chords of the roof trusses to external diagonal struts that transmit their loads into the boiler room framing.

Boilers supported from top

Design of seismic connections for the boilers presented difficulties since these units are hung from the top at a point about 100 ft. above the pile caps. Provision is made for several inches of vertical and horizontal thermal expansion of the boilers between operating and nonoperating conditions, yet, they are restrained from violent movement.

A typical example of seismic connection for the boilers is the support of the top boiler drum. At the south end of the drum, a knee brace is provided that projects down to within 1 in. of the drum top. The boiler drum is furnished with a 3-in. dia. pin projecting into a plate welded to the knee brace. This fixes the south end of the drum and takes care of the seismic forces in the north and south direction. Yet, it allows the drum to expand radially, up, down and northward. The west side of the drum is tied at the north and south ends by struts fastened to the drum with $1\frac{3}{4}$-in. dia. pins. These resist seismic forces in the east and west direction and at the same time allow the drum to expand northward and up or down.

The administration building, while adjoining the station, is designed as a separate unit, except for a common wall between the two structures. This three-story steel-frame structure has exterior walls, roof and floors of reinforced concrete. The floors and roof serve as horizontal diaphragms in transmitting the seismic forces to the exterior walls. These exterior walls, serve as vertical beams and deliver seismic forces to the footings.

Stacks are self-supporting on their

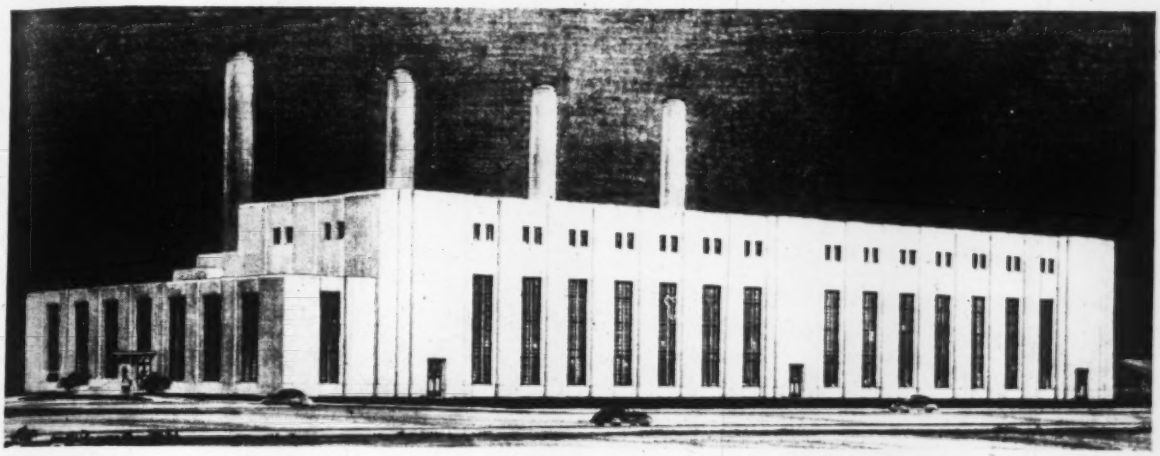


Fig. 5. Sketch of completed Redondo steam plant with office building in foreground. Each stack serves two units.

own foundations. They are 200 ft. high and 14 ft. inside diameter at the top. Construction is of reinforced concrete with an interior lining of acid-resistant brick, laid in acid-resistant mortar. The interior lining is supported on concrete brackets located 22 ft. on centers. These interior concrete brackets are slotted at 22½-deg. intervals for their full depth to provide ventilation between the lining and the stack and to reduce thermal stresses that would otherwise develop in an abruptly thickened section of the stack shell. Each stack serves two boilers.

Examination of the condition of reinforced concrete stacks designed as vertical cantilevers above their base, after they had been subjected to earthquake action, showed cracking developing between one-half and two-thirds of the height of the stack. This occurred even for stacks designed for a seismic coefficient of 0.2g indicating under-design of the stack shell between these heights.

Review of moments developed in the stacks, if designed as vertical cantilevers as compared with moments developed in accordance with the analysis proposed by LeConte for a slender vertical prismatic rod subject to sudden inertia force applied at its base, showed that the latter analysis required considerably more reinforcement in those portions of the stack where cracking had actually developed in earthquakes. Accordingly, starting at a height of 40 ft. above the foundation, which for this stack was the intercept between the moments developed between LeConte method and the cantilever method, the design moments resulting from the usual cantilever analysis were increased by a percentage proportional to the height of the point considered above the 40 ft. level and reinforcing was provided to satisfy these moments.

The design and construction of the plant is being done by the Stone & Webster Engineering Corporation under the direction of W. L. Chadwick, manager of engineering for the Southern California Edison Company. For Stone & Webster, Linton Kerr, structural engineer, is in charge of the structural design under the supervision of E. A. Dockstader, chief structural engineer. H. F. Cleary is construction superintendent on the project.

Major subcontractors on the job are as follows: Raymond Concrete Pile Co., piles and pile driving; Consolidated Steel Corp., fabrication and erection of structural steel; Consolidated Rock Products Co., ready mixed concrete; Macco Corp., intake and discharge tunnel; Alphons Custodis Chimney Construction Co., concrete chimneys.

Expansive Cement Used For Concrete Arch Keys

Five new concrete arches for the bomb-destroyed railway bridge at Laroche on the Paris-Lyon line have been freed from their centering by pouring crown keys of expansive-cement concrete, thus avoiding use of hydraulic jacks, according to the French magazine *Travaux*.

Each arch has a span of 66 ft. and a width of 45 ft. in. The arches were rebuilt in two layers in order to reduce the magnitude of the unbalanced thrusts on the bomb-weakened piers during the construction period. Much the same construction methods were followed for both upper and lower layers.

Each arch was poured in sections 6 ft. long. In the first layer's keystone position, a space of 3 ft. 10 in. across the width of the arch was left to receive the expansive concrete, the arch edges nearest this space being lightly reinforced with ⅜-in. rods. This key space—20 in. thick—was divided into four sections across the width of the arch by wooden forms.

The expansive concrete poured into these forms had the following proportions: 3.4 cu. ft. of gravel, 1.06 cu. ft. of sand, 1,320 lb. of expansive cement, and 50 gal. of water. The expansive cement is a mixture of portland cement, a sulphoaluminate cement (the expansive agent) and a slag cement, included as a retarder.

After the concrete was placed and while it was still wet, one-inch holes were made in it every 10 or 12 in. A plaster frame to retain water was fitted around the concrete's edge. Water was then poured into the holes and over the whole surface, to expand the concrete. Final net expansion was about 1/10 in. Subsequently, the joints were filled with mortar.

Fig. 1. Subgrade is stabilized by adding a calcareous dust and mixing to a depth of 6 in. with a rotary tiller.

Jacksonville Builds Oyster-Shell Pavement

***Contents in Brief**—In paving residential streets, the city of Jacksonville stabilizes the sandy subgrade by addition of a calcareous dust, followed by 6 in. of oyster shells which is compacted into a 3½-in. base. Surface treatment consists of an application of emulsified asphalt, 40 lb. per sq. yd. of slag, another application of asphalt, and finally a light coating of sand. Cost of the pavement, of which about 100,000 sq. yd. were put down in 1947, is about $1.25 per sq. yd., including engineering and supervision.*

IN KEEPING with a practice begun in 1938, the city of Jacksonville, Fla., this year is improving a large mileage of its residential streets by construction of a base of oyster shells, followed by a bituminous surface treatment. Although believed to be the only large municipality building this type of pavement, the city has found that the pavement compares favorably with other low-cost types.

The oyster-shell pavement is not only considered to be of low first cost, but of good maintenance characteristics. Other advantages cited by engineers of the city for this type of pavement are: Rapid construction is possible, work can be resumed almost immediately after rains, bleeding of the asphalt used in treating the surface seldom occurs, and construction can proceed under a wide range of air temperatures.

Use of oyster shells is limited to the paving of streets where traffic is primarily passenger cars or travel is of the type to be expected in residential areas. Utilization of the shells for paving work was begun nine years ago. Since then the use of this material has expanded until about 100,000 sq. yd. was put down in 1947, which was an increase of approximately 10 percent over 1946.

The oyster shell is available in large quantities from the St. Johns River about 20 miles downstream from Jacksonville. The material is obtained by hydraulic dredging and is delivered by barge at a cost of $1.75 per cu. yd. loose measurement.

In paving a street with shells, care is exercised to assure a subgrade of high stability. A sandy soil is generally encountered in most sections of Jacksonville, and the usual practice is to stabilize the subgrade. This is accomplished by over excavating, followed by the addition of a waste material known as oyster shell dust. The material is the fines obtained in the production of grit for feeding chickens, and it is produced by crushing the shells and removing the fines by washing. Normally 100 percent of the dust will pass the No. 80 sieve and 75 percent the No. 200.

In adding the dust, an amount may be used to make the dust equal to one-third of the top 6 in. of the subgrade. After the dust is added the top 6 in. is scarified and the materials uniformly mixed with rotary tillers of the type used so commonly on soil-cement work.

Experience has revealed that a better bond between the subgrade and the oyster shell pavement results if the subgrade is not compacted. Therefore, shaping of the subgrade with patrol graders is followed by addition of the shells, which have

Fig. 2. Curb and gutter is built during preparation of subgrade.

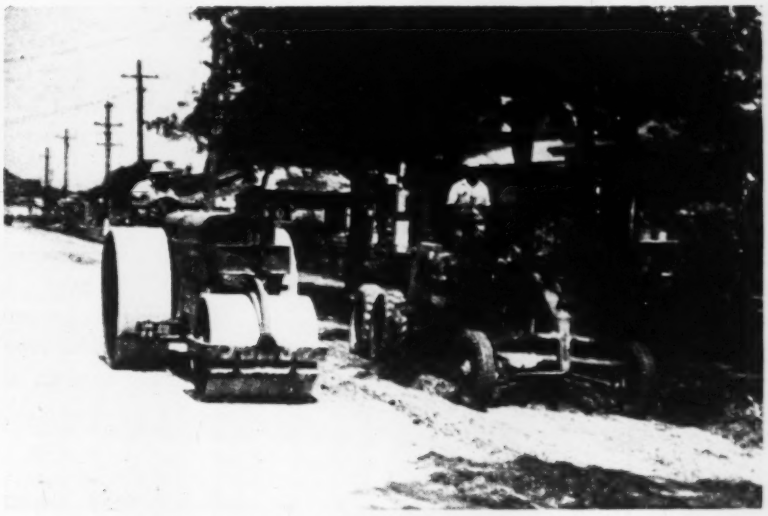


Fig. 3. As a smooth-wheel roller compacts the oyster shell base, it is continuously shaped with a motorized grader.

been washed in the mining process to remove all fine material.

Shells used for 3½-in. base

The usual practice is to add sufficient shells to provide an uncompacted depth of 6 in. This thickness is then reduced to about 3½ in. by compaction with 10-ton smooth steel-wheel rollers, the base being sprinkled heavily during the rolling. Addition of water at a high rate also continues during the shaping of the compacted shells with motorized graders. Immediately after this operation, or while the base contains a high water content, from 0.20 to 0.25 gal. per sq. yd. of quick-breaking rapid-curing emulsified asphalt is applied at a temperature of from 125 to 150 deg. F. The emulsified mixture normally consists of 40 percent water and 60 percent of 100 to 120 penetration asphalt.

In some cases a light coating of sand is next applied and the street opened to traffic until such time as the contractor is ready to finish the paving work. But in most cases the application of the prime coat is followed soon afterward by additon of 40 lb. per sq. yd. of slag with a maximum size of ¾-in. diameter. Rolling is accomplished the same day with an 8 to 10-ton smooth-wheel roller. This operation is followed soon afterwards by addition of between 0.60 to 0.75 gal. of the type of emulsified asphalt used for the prime and at the same temperature. Immediately afterward the pavement is lightly sanded, from 3 to 5 lb. per sq. yd. being used, or sufficient to eliminate the tackyness of the asphalt. The street is then opened to traffic.

Fig. 4. Surface treatment of the base calls for addition of 0.20 gal. per sq. yd. of asphalt and 40 lb. of slag, followed by about 0.60 gal. of asphalt as shown above.

Although it is optional with the property owners along the street being paved, a curb and cutter is usually built as part of the paving project. Constructed of portland cement concrete, the gutter is made 12 in. wide and 6 in. deep and the curb 6 in. wide and equally high and thus the concrete requirement is 1 cu. ft. per lin. ft. A concrete with a minimum compressive 28-day strength of 2,500 psi. is specified.

Cost of the street pavement, including engineering and supervision of construction, and all materials is $1.25 per sq. yd. An average contract price for the curb and gutter is from $1.00 to $1.05 per lin. ft.

Normally, both types of work are performed by general contract. The paving work illustrated was carried out by the Duval Engineering Co., Jacksonville, Fla.

W. E. Sheddon, city engineer of Jacksonville, is in general charge of the city's paving work, and H. T. Broadstreet, paving engineer, is in direct charge of the construction operations.

Tri-Valve Manifold Controls Water Flow

Contents in Brief—Water flow rate through a new 68-in. line supplying the city of San Diego will be accurately controlled by three main valves, each set in a separate leg of a manifold. The design is intended to minimize danger of chattering and cavitation of the valves. Part of a multi-million dollar water supply expansion program, this manifold will combine flow through four pipelines from two reservoirs, one of which is the terminus of the San Diego Aqueduct.

TO MINIMIZE the danger of chattering and cavitation that would result from throttling a single large valve to permit a low rate of flow, water entering a new 68-in. line on the San Diego water supply system will be regulated by a manifold with three legs, each having a main control valve.

The manifold is located some 12 miles from the city's proposed filtration plant and is at the junction of pipelines leading to San Vicente and El Capitan reservoirs. As there is no major storage available between Lakeside, the small town at the junction, and the city, it will be necessary to vary the flow through the new line in accordance with demand. Accordingly, the three-leg system was adopted to obviate any dangers inherent in the operation of a single large valve during periods of low flow demand.

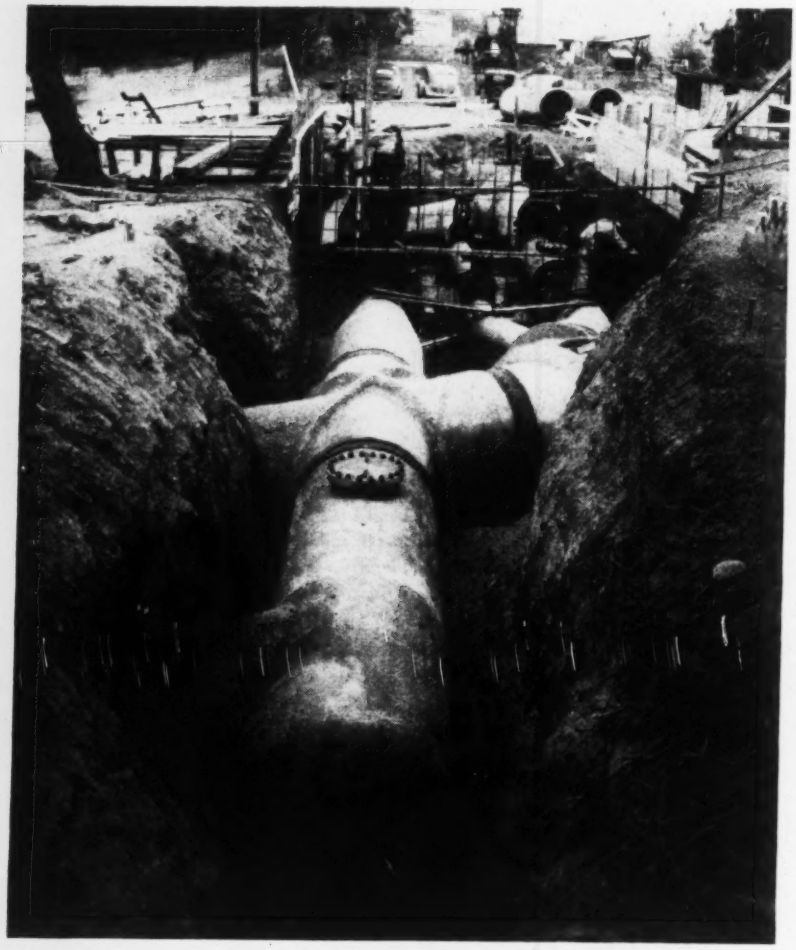


Fig. 1. This manifold being installed on the San Diego water supply system will combine flow from four pipelines at any rate desired and feed it into a new 68-in. line. The bulkheaded end in the foreground will be removed when a 48-in. line connecting with San Vicente reservoir is tied into the system.

Four lines are joined

Four lines will lead into the junction, two (42½ and 48 in.) from the terminus for the San Diego Aqueduct (*ENR* Mar. 6, vol. p. 362) and San Vicente reservoir, and two (36 and 48 in.) from the El Capitan reservoir. The 36-in. line from El Capitan reservoir continues to the city. It was installed some years ago when the reservoir was completed and has long been overtaxed.

Since the completion of San Vicente Dam in 1943, plans were completed and work undertaken on the San Diego Aqueduct which has its terminus in the San Vicente reservoir. To provide capacity to carry the Colorado River water brought in by this aqueduct, a 48-in. line is under construction from San Vicente to Lakeside to supplement the existing 42½-in. line. Further capacity from El Capitan reservoir was provided by recent completion of a 48-in. line.

To carry water from all these sources from Lakeside to San Diego, a new 68-in. line is being built. Both the 36-in. and the 68-in. line will be maintained for the present, allowing a flexibility of operation. After completion of the filter plant, the 36-in. line will be abandoned and portions salvaged. A large feeder line will be built from the plant to the city.

Tri-valve manifold

The manifold, key feature in the junction of these pipelines, consists of three legs, two 30 in. dia. and one 16 in. dia. The two 30-in. legs are provided with cone valves and the 16-in. leg with a plug valve. For extremely

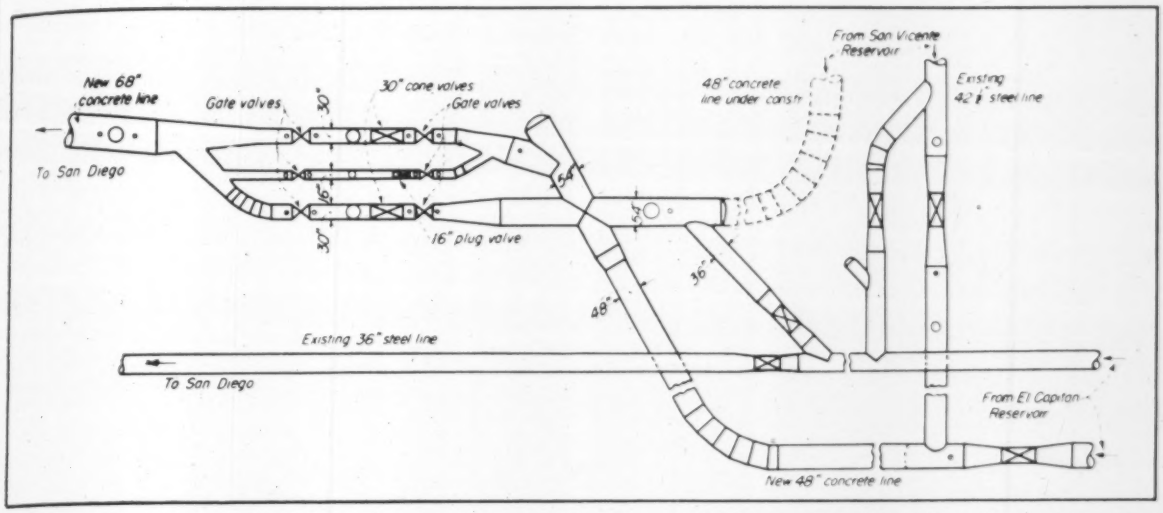


Fig. 2. Relationship of the various lines is shown in this sketch. The manifold has two 30-in. legs and one 16-in. leg, each of which is equipped with an independently operated main control valve. By manipulating the rate in each branch, the water flow can be accurately controlled without the risk of damage to the valves.

low flows, the 16-in. line will be used by itself. For rates up to and including full flow, the valves will be used in various combinations. In this manner, none of the valves need be open only a small amount. When a valve is to be opened, it can be opened considerably or not at all with a minimum of danger from cavitation, scouring, pitting, chattering, or other hazardous conditions.

No precedent was available for the design of this installation and no criteria were available for the computation of the sizes of manifold branches and the like. The completed design represents the best engineering judgment of the men involved and, if anything, is believed to be on the conservative side. The designers feel that at such an important point in the water supply for a city the size of San Diego a safe design is essential.

G. E. Arnold is director of the San Diego Water Department and the design of this system was prepared under the direction of Fred D. Pyle, hydraulic engineer, and Paul Beermann, assistant hydraulic engineer. The manifold was built and installed by the American Pipe and Construction Co., Southgate, Calif., R. V. Edwards, vice-president.

Cast-Iron Turnings Aid Sewage Treatment

Methods undertaken in the Niers River district in Germany to cope with the disposal of city sewage heavily polluted by industrial effluents are described in a report now on sale by the Office of Technical Services, Department of Commerce.

The report prepared by George Ornsen, a consulting chemist, of New York City concludes that the sewage disposal process developed accomplishes its intended purpose economically and deserves consideration where waste is wholly or in major part of industrial origin.

The Niers River, a small tributary of the lower Rhine, flows at the rate of about 15,000 gpm. It receives waste of textile mills, bleacheries, dye works, tanneries, and paper and straw mills. The concentration and composition of these effluents (7.5 mgd.) produces pollution equivalent to domestic sewage contributed by 600,000 people. To this daily load is added 5.0 mg. of the domestic sewage from 200,000 inhabitants. Thus the 12.5 mg. of sewage to be treated daily corresponds in degree to pollution to a total of 20.0 mg. of domestic sewage while the rate of flow of the Niers River amounts to only 21.6 mgd.—a ratio of almost 1:1.

Early laboratory tests using conventional methods of precipitation with ferric chloride, settling, and aeration with activated sludge resulted in a satisfactory effluent. However, the sludge was very difficult to digest and costs estimated on a mass basis were prohibitive. To overcome these drawbacks, the Niers process was developed by a German chemist, H. Jung.

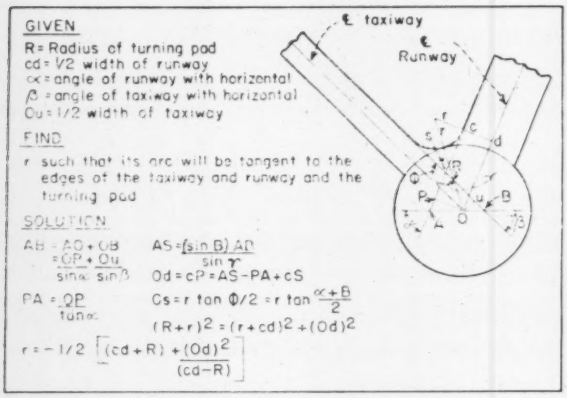
The difficulty of digesting sludge properly was solved by depriving the sludge of part of its iron content, and mixing it, prior to digestion with the other sludges produced in the disposal plant.

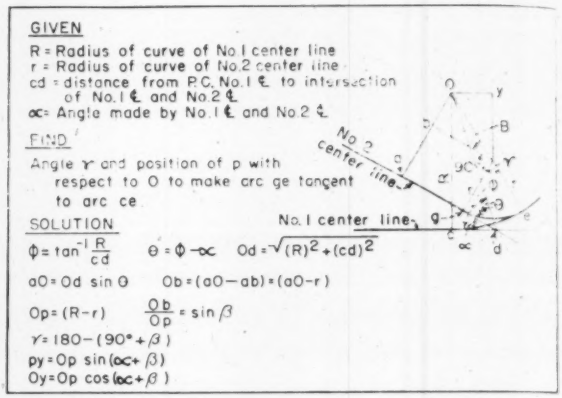
The cost problem was solved by using cheap cast iron turnings as the sole initial source of iron, instead of iron compounds, and by recovering about 60 percent of the iron from the sludge for rinse. Ferric hydroxide in sludge is reduced to ferrous hydroxide by aeration and the latter is dissolved by carbon dioxide to form soluble ferrous bicarbonate. Stack gases containing 10-12 percent carbon dioxide are mixed with incoming sewage under slight pressure before treatment with fine iron particles.

The report describes present operating and processing practices in detail, use of sludge as fertilizer and sewage gas (methane, 90-94 percent) as an automobile fuel, and gives the construction costs.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS


GIVEN
R = Radius of turning pad
cd = 1/2 width of runway
α = angle of runway with horizontal
β = angle of taxiway with horizontal
Ou = 1/2 width of taxiway
FIND
r such that its arc will be tangent to the edges of the taxiway and runway and the turning pad
SOLUTION
AB = AO + OB = OP + Ou / sinα sinβ
PA = OP / tanα
AS = (sin B) AP / sin γ
Od = cP = AS − PA + cS
Cs = r tan Φ/2 = r tan (α+B)/2
(R+r)² = (r+cd)² + (Od)²
r = − 1/2 [(cd+R) + (Od)² / (cd−R)]
℄ taxiway
℄ Runway


GIVEN
R = Radius of curve of No.1 center line
r = Radius of curve of No.2 center line
cd = distance from P.C. No.1 ℄ to intersection of No.1 ℄ and No.2 ℄
α = Angle made by No.1 ℄ and No.2 ℄
FIND
Angle γ and position of p with respect to O to make arc ge tangent to arc ce
SOLUTION
Φ = tan⁻¹ R/cd θ = Φ − α Od = √((R)² + (cd)²)
aO = Od sin θ Ob = (aO − ab) = (aO − r)
Op = (R − r) Ob/Op = sin β
γ = 180 − (90° + β)
py = Op sin (α + β)
Oy = Op cos (α + β)
No. 2 center line
No. 1 center line

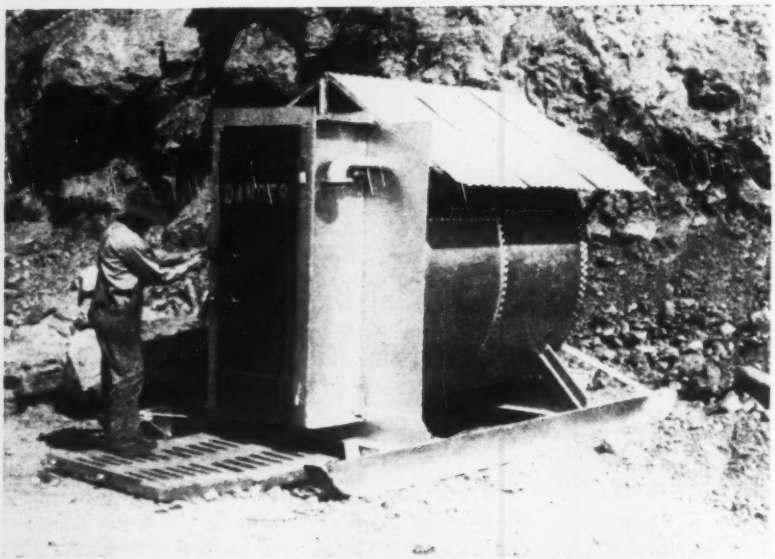
HOW TO LOCATE CURVES IN AIRPORT SURVEYING

In airport surveying, the radius of a curve tangent to two straight lines and also tangent to a second curve is often desired. The solution is given at the left. In highway and railroad work, location of a curve tangent to another curve is sometimes required. The solution to this problem is given at the right.—Sidney L. Goldberg, St. Paul Structural Steel Co., St. Paul, Minn.

Good Powder Storage House Made of Surplus Materials

A storehouse for blasting powder, having the advantage of the protection afforded by ½-in. steel plate plus ready portability, was built by the Macco Construction Co., San Francisco, and later acquired by Easley and Brassy for use in the excavation that provides cover for the San Francisco sanitary fill.

The main body of the house, a cylinder 6 ft. long and 6 ft. in diameter, lying on its side, was once part of an old steam boiler. The open end, which had been cut off with a torch, was closed by welding on a double pair of half-inch steel plate doors that once served as the entrance to a fireproof vault. The structure was provided with a base by a simple framework made from the two halves of a 16-in. I-beam burned in two longitudinally along the center line of the web. With portions of the web cut away at both ends so the bottom flange could be curved upward, the two halves of the I-beam serve as a pair of skids. It only remained to give all the steel a coat of aluminum paint and put on a "bonnet" of galvanized iron to afford shade, and the structure was ready to function. The important item of ventilation is provided by a 3-in. pipe whose outer end is seen at the right of the door. This pipe, along the top of the chamber, permits circulation of air coming in through slots in the steel bottom.



Powder house, made from part of old steel boiler, has two pairs of doors, convenient skid mounting, and vent pipe.

Tables Aid In Designing Laterally Unsupported Beams

Economical selection of rolled steel beams is simplified through the use of the accompanying table. It is

based on provisions for stresses in laterally unsupported beams in the American Institute of Steel Construction "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings".

When Ld/bt is less than 600, the allowable stress is 20,000 psi. (L is the laterally unsupported span, d the depth of the beam, b the flange width and t the flange thickness, all in inches). When Ld/bt is greater than 600, the allowable stress is $f = 20{,}000\ L_u/L$, where L_u is the value of L when $Ld/bt = 600$.

Substituting for f in $M/f = S$, where M is the bending moment in in.-lb. and S the required section modulus, and putting $M/20{,}000 = S'$ we obtain

$$S'L = SL_u$$

The right hand expression in this equation is a constant for each rolled section and is given in the accompanying table, whereas the left hand term is computed.

To select the lightest beam for given conditions, divide the bending moment by 20,000 to obtain S' and multiply by the laterally unsupported span in feet. In the SL_u column in the table, find the first value equal to or greater than this product. The corresponding beam is the one sought, providing it has a section modulus greater than S'. Otherwise, proceed down the table until a section is found for which S exceeds S'.

For example, to determine the economical wide-flange section for use as a beam subject to a maximum moment of 49 ft.-kips, when the laterally unsupported span is 15 ft., first compute $S' = 49 \times 12/20 = 29.4$. Then calculate $S'L = 29.4 \times 15 = 441$. In the wide-flange group in the table, the first value of SL_u larger than 441 is 457, but S for this beam (L less than L_u) is only 24.3. Therefore, the 12 WF 31, with $S = 39.4$, is the first section to satisfy the criteria.—WILLIAM P. STEWART, *Structural Engineer, Day & Zimmermann, Inc., Philadelphia, Pa.*

TABLE FOR ECONOMICAL SELECTION OF BEAMS

SL_u	S	Section	L_u
WIDE-FLANGE BEAMS			
142	14.1	8 WF 17	11.1
208	17.0	8 WF 20	12.2
213	21.5	10 WF 21	9.9
324	26.4	10 WF 25	12.3
339	20.8	8 WF 24	16.3
372	34.1	12 WF 27	10.9
389	41.8	14 WF 30	9.3
437	30.8	10 WF 29	14.2
457	24.3	8 WF 28	18.8
493	39.4	12 WF 31	12.5
529	48.4	14 WF 34	10.9
529	56.3	16 WF 36	9.4
592	27.4	8 WF 31	21.6
616	35.0	10 WF 33	17.6
665	45.9	12 WF 36	14.5
671	54.6	14 WF 38	12.3
708	64.4	16 WF 40	11.0
759	31.1	8 WF 35	24.4
890	72.4	16 WF 45	12.3
895	42.2	10 WF 39	21.2
898	51.9	12 WF 40	17.3
966	62.7	14 WF 43	15.4
1060	89.0	18 WF 50	11.8
1100	80.7	16 WF 50	13.6
1120	58.2	12 WF 45	19.2
1200	49.1	10 WF 45	24.5
1210	70.2	14 WF 48	17.2
1290	98.2	18 WF 55	13.1
1370	64.7	12 WF 50	21.2
1480	77.8	14 WF 53	19.0
1520	54.6	10 WF 49	27.9
1530	126.4	21 WF 62	12.1
1550	107.8	18 WF 60	14.4
1620	94.1	16 WF 58	17.2
1690	70.7	12 WF 53	23.9
1850	60.4	10 WF 54	30.6
1880	139.9	21 WF 68	13.4
1950	117.0	18 WF 64	16.7
1980	104.2	16 WF 64	19.0
2050	78.1	12 WF 58	26.3
2130	92.2	14 WF 61	23.1
2170	150.7	21 WF 73	14.4
2250	175.4	24 WF 76	12.8
2260	67.1	10 WF 60	33.6
2330	128.2	18 WF 70	18.2
2430	115.9	16 WF 71	21.0
2630	88.0	12 WF 65	29.9
2640	103.0	14 WF 68	25.6
2690	73.7	10 WF 66	36.5
2830	196.3	24 WF 84	14.4
2850	141.7	18 WF 77	20.1
2870	168.0	21 WF 82	17.1
2940	127.8	16 WF 78	23.0
3120	112.3	14 WF 74	27.8
3210	97.5	12 WF 72	32.9
3360	242.8	27 WF 94	13.9
3420	156.1	18 WF 85	21.9
3600	220.9	24 WF 94	16.3
3720	121.1	14 WF 78	30.7
3860	107.1	12 WF 79	36.0
3950	197.6	21 WF 96	20.0
4010	299.2	30 WF 108	13.4
4070	266.3	27 WF 102	15.3
4270	151.3	16 WF 88	28.2
4310	130.9	14 WF 84	32.9
4490	115.7	12 WF 85	38.8
4830	248.9	24 WF 100	19.4
4930	138.1	14 WF 87	35.7
4890	327.9	30 WF 116	14.9
4960	184.4	18 WF 96	26.9
5130	166.1	16 WF 96	30.9
5150	299.2	27 WF 114	17.2
5740	354.6	30 WF 124	16.2
5800	150.6	14 WF 95	38.5
5870	274.4	24 WF 110	21.4
5900	202.2	18 WF 105	29.2
6030	404.8	33 WF 130	14.9
6610	379.7	30 WF 132	17.4
6660	249.6	21 WF 112	26.7
6910	299.1	24 WF 120	23.1
6960	220.1	18 WF 114	31.6
7420	446.8	33 WF 141	16.6
7900	502.9	36 WF 150	15.7
8610	284.1	21 WF 127	30.3
8570	330.7	24 WF 130	25.9
8850	486.4	33 WF 152	18.2
9200	541.0	36 WF 160	17.0
10230	402.9	27 WF 145	25.4
10600	579.1	36 WF 170	18.3
10660	317.2	21 WF 142	33.6
10880	372.5	24 WF 145	29.2
12180	621.2	36 WF 182	19.6
12360	444.5	27 WF 160	27.8
13360	413.5	24 WF 160	32.3
13870	663.6	36 WF 194	20.9
14100	528.2	30 WF 172	26.7
15110	492.8	27 WF 177	30.7
17340	586.1	30 WF 190	29.6
18410	669.6	33 WF 200	27.5
21250	649.9	30 WF 210	32.7
22440	740.6	33 WF 220	30.3
24150	835.5	36 WF 230	28.9
26850	811.1	33 WF 240	33.1
27540	892.5	36 WF 245	30.9
31290	951.1	36 WF 260	32.9
36810	1031.2	36 WF 280	35.7
42180	1105.1	36 WF 300	38.2
LIGHT BEAMS			
62	9.9	8 LB 13	6.3
67	7.2	6 LB 12	9.3
71	13.8	10 LB 15	5.1
79	17.5	12 LB 16½	4.5
91	11.8	8 LB 15	7.7
105	16.2	10 LB 17	6.5
122	21.4	12 LB 19	5.7
131	10.1	6 LB 16	13.1
145	18.8	10 LB 19	7.7
175	25.3	12 LB 22	6.9
JOISTS			
33	5.1	6x4 J 8½	6.5
40	7.8	8x4 J 10	5.1
43	10.5	10x4 J 11½	4.1
55	14.8	12x4 J 14	3.7
STANDARD MILL BEAMS			
144	14.0	8 M 17	10.3
159	15.2	8 M 20	10.5
236	21.7	10 M 21	10.9
262	23.6	10 M 25	11.1
320	21.0	8 M 24	15.2
350	22.5	8 M 28	15.6
JUNIOR BEAMS			
7	2.4	6 JR 4.4	2.9
10	3.5	7 JR 5.5	2.8
13	4.7	8 JR 6.5	2.7
14	5.8	9 JR 7.5	2.5
20	7.8	10 JR 9.0	2.5
23	9.6	11 JR 10.3	2.4
38	12.0	12 JR 11.8	3.2
JUNIOR CHANNELS*			
10	4.4	10 [6.5	2.3
12	6.5	10 [8.4	1.9
18	9.3	12 [10.6	2.0
STANDARD I-BEAMS			
17	1.7	3 I 5.7	10.1
21	1.9	3 I 7.5	10.8
29	3.0	4 I 7.7	9.7
34	3.3	4 I 9.5	10.2
47	4.8	5 I 10.9	9.8
64	6.0	5 I 14.75	10.7
73	7.3	6 I 12.5	10.0
93	8.7	6 I 17.25	10.7
106	10.1	7 I 15.3	10.2
130	12.0	7 I 20.0	10.8
151	14.2	8 I 18.4	10.6
178	16.0	8 I 23.0	11.1
278	24.4	10 I 25.4	11.4
353	29.2	10 I 35.0	12.1
407	36.0	12 I 31.8	11.3
435	37.8	12 I 35.0	11.5
645	44.8	12 I 40.8	14.4
671	58.9	15 I 42.9	11.4
751	64.2	15 I 50.0	11.7
751	64.2	15 I 50.0	11.7
760	50.3	12 I 50.0	15.1
1020	88.4	18 I 54.7	11.5
1220	101.9	18 I 70.0	12.0
1440	116.9	20 I 65.4	12.3
1590	126.3	20 I 75.0	12.6
2210	173.9	24 I 79.9	12.7
2400	185.8	24 I 90.0	12.9
2430	150.2	20 I 85.0	16.2
2590	197.6	24 I 100.0	13.1
2640	160.0	20 I 95.0	16.5
4240	234.3	24 I 105.9	18.1
4640	250.9	24 I 120.0	18.5
STANDARD CHANNELS*			
7	1.1	3 [4.1	6.4
8	1.2	3 [5.0	6.8
10	1.4	3 [6.0	7.2
11	1.9	4 [5.4	5.9
15	2.3	4 [7.25	6.4
17	3.0	5 [6.7	5.6
21	3.5	5 [9.0	6.0
24	4.3	6 [8.2	5.5
29	5.6	6 [10.5	5.8
33	6.0	7 [9.8	5.5
36	5.8	6 [13.0	6.2
39	6.9	7 [12.25	5.7
45	8.1	8 [11.5	5.5
46	7.7	7 [14.75	6.0
51	9.0	8 [13.75	5.7
59	10.5	9 [13.4	5.6
64	11.3	9 [15.0	5.7
67	10.9	8 [18.75	6.2
76	13.4	10 [15.3	5.7
82	13.5	9 [20.0	6.1
94	15.7	10 [20.0	6.0
114	18.1	10 [25.0	6.3
131	21.4	12 [20.7	6.1
136	20.6	10 [30.0	6.6
153	23.9	12 [25.0	6.4
178	26.9	12 [30.0	6.6
309	41.7	15 [33.9	7.4
351	46.2	15 [40.0	7.6
421	61.0	18 [42.7	6.9
429	53.6	15 [50.0	8.0
440	63.7	18 [45.8	6.9
491	69.1	18 [51.9	7.1
544	74.5	18 [58.0	7.3

*These sections should also be investigated for torsion.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Colorado Water Language

Sir: The story concerning the Colorado-Big Thompson project (*ENR* Dec. 11, 1947, vol. p. 793) is an excellent piece of work. However, there is one thing, which, from a hasty examination of the story, I wish were changed.

At several places in the story the Green Mountain reservoir water is stated to be "compensation" for Western Colorado. It is recognized that both this word and the word "replacement" have been used. If the actual situation is clearly understood, it will be realized that "replacement" is the correct word.

Irrigation has been practiced in Western Colorado for as much as 70 years. Any user of water for a beneficial use in Colorado must, to secure a right to the use of that water, appear in the proper district court and make a claim which consists of two essential elements. First, the quantity of water that he has beneficially used, next, the date on which he began that use. If the court finds that his claims are allowable, he is given what is called a "priority," that is the right to divert a certain quantity of water which right is held to have originated on a certain date. Obviously there is in every Western Colorado locality a list of such priorities which represents the relative rights of water users and if at any time, when such use is necessary, the source of water will not supply all those on the list, the later ones are shut off, down to the point where the water supply that is available permits such use.

It must be obvious that if a large quantity of water is taken from the headwater area of Colorado river, there will be times when rights lower down in Western Colorado cannot obtain the water to which by their seniority they are entitled. It is the purpose of Green Mountain reservoir to store from the annual flood a quantity of water which is a result of careful study it is believed will "replace" the proposed diversion and deliver to the senior rights on Colorado river the water to which by that seniority they are entitled.

From the foregoing explanation it should be apparent that this involves no compensation whatever. It is merely a replacement from stored water of the natural flow to which the senior rights are entitled.

It is primarily for the benefit of the diversion project since if replacement were not provided, that project would be prevented from storing or diverting directly water which by its position is divertible. It is thus a gain in this case of some 52,000 acre-feet a year in the quantity of water that can be diverted to Eastern Colorado.

It is hoped that this explanation may receive adequate publicity for it is very strongly felt in Colorado that a proper definition of the function of such reservoirs as that at Green Mountain is essential to a correct understanding of diversion projects.

F. C. MERRIELL
Secretary, The Colorado River Water Conservation District
Grand Junction, Colo.

Horizontal Shear Connectors

Sir: It is an interesting and likewise important question that Mr. Balog raises (*ENR* Jan. 8, 1948, vol. p. 64) regarding the necessity for employing connecting devices between concrete slabs and steel supporting beams in order to obtain composite-beam action between them.

Undoubtedly there is a most intimate bonding contact between the minute surface irregularities of the steel and the concrete which sets and hardens upon it, quite different from the condition obtaining when wet concrete rises and contacts the underside of steel surfaces and water gain destroys the bond. In addition to this, gravity acts at all times on the supported slab to maintain this intimate contact. Furthermore, live-loads have in general the same effect, although by their positioning upon continuous slab spans they may sometimes produce a loosening effect. Rivet heads create a very definite mechanical interlock. However, mechanical interlock by effective shear keying is further assurance of positive interaction of the two materials.

Mr. Balog refers to the Cattaraugus Creek Bridge (*ENR* Dec. 26, 1946, vol. p. 856). The illustrations show the use of a welded spiral connector, and the article states that calculations for this spiral were analagous to those set forth in the article "Strengthening Our Highway Bridges" (*ENR* Feb. 26, 1942, vol. p. 339).

This earlier article presents design calculations in considerable detail and illustrates the spiral use specifically by the case of a ½-in. round rod bent to a 4-in. mean diameter. The allowable stress in the rod at 16,000 p.s.i. is correctly stated to be 3.14k. "Since the spiral on one side of the weld is in compression and on the other in tension, the weld" (by which it is attached to its beam) "must withstand a total load of 6.28 k." Then under the stated horizontal shear increment between slab and beam of 1.47 k. per in. the pitch of the spiral is computed to be $\frac{6.28}{1.47}$ or 4 in.

Perhaps this is a late date to raise the question, but assuming that 6.28 k. of longitudinal or axial stress gets into the bar by some combination of bond and bearing in a 4-in. distance along the beam length or in 13.2 in. of bar length, the writer is completely at a loss to see how 100 per cent of this stress acts effectively along the beam when the spiral crosses the beam at an angle whose tangent is

$$\frac{\text{pitch}}{\text{circumference}} = \frac{4.0}{12.57} = 0.318$$

and whose sine is 0.303.

It may therefore be that here is another bridge supporting Mr. Balog's suggestion that the contact resulting from pouring slab upon beam is itself sufficient to establish structural interaction between the two. This matter may warrant further consideration.

HOMER HADLEY
Consulting Engineer
Seattle, Wash.

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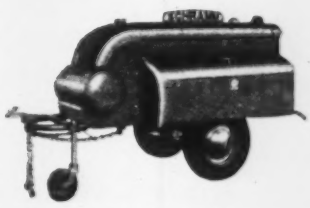

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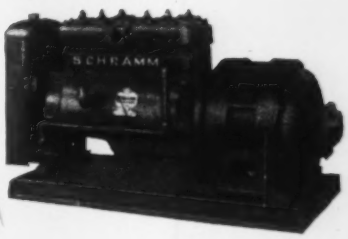

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Write for bulletins and prices.

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

April Materials and Labor Prices will appear in the April 15, 1948 issue

CEMENT, AGGREGATE, READY-MIXED CONCRETE — F. O. B. CITY

	PORTLAND CEMENT* Per bbl. C/L lots incl. $1.00 per bbl. for bags, cash. dis. not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		READY MIXED CONCRETE 1:2:4, over 50 c.y., del.
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand grav.	Lt.wgt.Agg.	
Atlanta	$4.03	$3.26	$2.98	$2.00	$2.00	$1.75	$2.10	$2.10	$1.65	$1.85	$0.1725	$0.1725	$11.00
Baltimore	3.91	3.14	2.86	2.20*ff*	2.20*ff*	1.80*ff*	2.40*ff*	.....	2.35*ff*	2.35*ff*	.15	.15*w*	9.20
Birmingham	3.65	2.88	2.55	2.06	2.06	1.66	2.50	2.50	1.00	1.20	.15	.15	7.45
Boston	4.39	3.62	3.34	1.50‡	1.50‡	1.40‡	1.25‡	1.35‡	....	....	.186	.195*w*	10.50*m*
Chicago	3.65	2.88	2.60	2.70‡*d*	2.70‡*d*	2.95‡*d*	2.60‡*d*	2.60‡*d*	2.00‡	2.00‡	.20	.20*x*	....
Cincinnati	3.87	3.10	2.82	1.85‡*pp*	1.85‡*pp*	1.75‡*pp*	2.75‡*pp*	2.75‡*pp*	....	....	.19	.195	10.05*hh*
Cleveland	3.82	3.05	2.72	1.90*llw*	1.65*llj*	1.45*ll*	3.45‡*h*	3.45‡*h*	2.60	2.60	....	.21	11.25*ww*
Dallas	3.57	2.80	2.52	2.00	2.15	1.75	2.00	2.10	....	....	.0775*p*	....	8.85
Denver	.....	3.32	3.02	1.85	2.00	1.15	....	....	....	....	.20†	.2175*w*	9.65
Detroit	3.54	2.74	2.49	3.00‡	3.00‡	2.75‡	2.75‡	2.75‡	2.75‡	2.75‡	.17	.18*w*	9.15*kk*
Kansas City	3.68	2.88	2.63	2.05	2.05	1.40‡	1.45*q*	1.45*q*	....	....	.16*wf*	.175*ay*	9.85*n*
Los Angeles	....	3.60*b*	3.20*b*	1.92‡	2.02‡	1.72‡*mn*	1.92‡	1.92‡	....	....	.08*oo*	....	9.90*m*
Minneapolis	3.91*dd*	3.14*dd*	2.86*dd*	2.10*h‡j*	2.10*h‡j*	1.20*h‡j*	2.20*h‡j*	2.20*h‡j*	....	....	.19*cco*	....	10.05*jkk*
Montreal	....	2.29*r*	2.14*r*	1.78*bbs*	1.78*bbs*	1.10*s*	1.55*cs*	1.80*cs*	....	....	.1936	.21*w*	7.75*s*
New Orleans	3.63	2.88	2.58	2.13	2.13	1.67	....	....	.90	1.15	.23	....	10.65
New York	....	4.00‡	....	1.85*de*	1.85*de*	1.30*de*	2.00*dv*	2.00*dv*	....	....	.18*ii*	.174*wccii*	10.50*k*
Philadelphia	3.71‡	2.94‡	2.66‡	2.20‡	2.30‡	2.05‡	1.90‡	1.95‡	1.50	1.50	.22/.25	.22/.25*w*	9.85
Pittsburgh	3.78	3.01	2.73	2.05‡	2.05‡	2.35‡	2.50‡	2.50‡	2.05	2.05	.22*s*	.22*s*	10.85
St. Louis	3.76*o*	2.99*o*	2.71*o*	2.35‡*oh*	2.35‡*oh*	2.00/2.35‡*oh*	1.50*c*	1.50*c*	1.15	1.15	.195	.22*yo*	10.40
San Francisco	.....	3.36	2.96	1.77	1.77	1.87	1.87	....	....	....	....	.25*y*	10.75*u*
Seattle	.....	3.45*mm*	2.95*mm*	2.75‡*od*	2.75‡*od*	2.75‡*od*	3.50‡*od*	3.50‡*od*	....	....	.20*o*	....	9.75*u*

‡ Delivered. *a* F.o.b. truck at plant. *b* 10c. per bbl. off for payment by 10th of following month. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks, Man. *f* F.o.b. truck on job. *g* Pea gravel. *h* Truck Lots. *i* ½ in. *j* 5% discount for cash. *k* 5 cu. yds. or over, del. Man. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* F.o.b. truck at plant. *r* 10¢ per bbl. off cash 20 days. *s* Sales tax included. *t* Truck delivery. *u* 10 to 100 c.y. brackets. *v* F.o.b. scow, Hudson River, N. Y. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Aver. haul, 7–9 mi. zone. *bb* Under 5 tons. *cc* 8 x 8 x 18 in., 18.2¢. *dd* Dealers sell only in LCL. This is price for CL and does not include dealer's commission. *ee* 20c refund for each returnable bag. *ff* LCL. *gg* 10c. refund for each returnable bag. *hh* Truck loads up to 500 c.y. Over 500 c.y lots, 50¢ less per yd. *ii* Yard price. *kk* 2500 lb. compression strength *jj* 30¢ refund for each returnable bag. *ll* Price at plant, called for. *mm* 10¢ per bbl. off cash 10 days. *nn* Concrete sand *oo* 4x8x12 std. wgt. *pp* 5 tons or more. *Prices include dealer's commission except where indicated to the contrary. † Comparable prices for July-Nov., 18¢; Dec.-Feb., 20¢.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05 per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 28c. per bbl., not refundable

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$2.10	$2.10	Ironton, Ohio	$2.15*	$2.15*	Universal, Pa.	$2.20	$2.20
Hannibal, Mo.	2.20	2.20	Northampton, Pa.	2.15	2.15	Waco, Tex. (Plus 9c. tax in Tex.)	1.95	1.95
Independence, Kans.	2.20	2.20	Richard City, Tenn.	2.20	2.20	Montreal City (Discount 10c. per bbl. 20 days)	1.98	1.98
			Steelton, Minn.	2.30	2.30			

* Destination price base effective Dec. 22, 1947

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS — F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration		CUTBACK ASPHALT Per ton		ROAD OIL Per gal.	ASPHALT EMULSION (Quick-breaking) Per gal.	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums		Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	.....	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70‡	.....	15.00	$21.00	.0925	$0.1225	15.00	$25.00	.095	.095	$0.115
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	17.00*o*	29.50*o*	.0723*o*	.1447*o*	.075*ho*	.15*ho*	.07*o*	.0907*o*	.18*o*
Chicago	150.00‡*y*	75.00/80.00*ze*	2.97/4.10*d*‡	22.50*b*	32.00*b*	21.50*bg*	31.00*bg*	.097/.10*bh*	.....	.082/.0845*b*	.0925/.1025*b*	.14/.165*b*
Cincinnati	.....	.....	.....	22.60*s*	.....	.....	.....	24.50	24.50	.....	.....	.....
Cleveland	186.52	47.00*t*	3.84*u*	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dallas	*l*	40.00	*l*	23.38	42.17	.0987	.1837	26.15	46.65	.0962	.1037	.....
Denver	.....	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	63.00*x*	.....	20.00	26.00	18.40*g*	24.40*g*	.0811*h*	.128*h*	.075	.1085	.1522
Kansas City	.....	40.00*q*	.....	24.45*r*	.....	.....	.....	.081*hr*	.....	.071*r*	.....	.....
Los Angeles	*l*	.....	*l*	16.00*mf*	32.75*mf*	16.00*jm*	32.75*m*	16.50*m*	33.25*m*	15.50*jm*	.0675*cc*	.1375*cc*
Minneapolis	.....	.....	2.74*d*	28.00	37.00	23.00*g*	34.00*g*	27.00	38.00	.105	.13	.23
Montreal	125.00	.....	.....	21.60*k*	31.25*k*	14.10*kp*	18.35*kp*	14.00*kp*	16.00*kp*	12.50*kj*	.153*k*	.194*k*
New Orleans	.....	.....	.....	20.00*a*	.....*e*	20.00*ga*	.....*e*	9.50*a*	.....*e*	.095	.0975	.16*n*
New York	.....	.....	2.50*d*	25.95	36.35	24.95*g*	42.79*g*	.1068*h*	.1832*h*	.1018	.1066	.1889
Philadelphia	150.00	62.00	4.06	23.00	.....	22.00*g*	.....	.095*h*	.....	.....	.....	.....
Pittsburgh	165.00	42.00	4.10	22.00	34.00	.11	.20	23.00	36.00	.09	.10	.20
St. Louis	.....	48.50	.....	16.50/17.50	22.50/23.00	15.50/16.00*g*	21.50/22.00*g*	.075/.08*h*	.165/.17*h*	.065/.07	.075/.095	.125/.155
San Francisco	.....	57.75*c*	.....	16.50	33.75*w*	16.50*g*	.....	17.50	.....	.....	.0625	.1325
Seattle	.....	.....	.....	16.50*i*	33.00*i*	15.00*ig*	.....	18.00*i*	22.00*aai*	16.00*ij*	.0625*i*	.0725*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. refinery. *c* 2½ x 8½ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *f* 40–80 penetration. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* Shipped in drums, per drum. *k* Tax included. *l* Not used. *m* F.o.b. refinery, El Segundo. *n* 55 gal. drums. *o* Price at plant, in Everett. *p* Per 100 gal. *q* F.o.b. Buffalo. *r* F.o.b. Sugar Creek, Mo. *s* Drums not available. *t* Truck deliveries in Greater Cleveland. *u* 3-in. *w* Shipped in double head wood barrels. *x* Truck deliveries in Detroit $75.00. *y* Carload lots. *z* 50–300 penetration. *aa* In customer's drums. *cc* F.o.b. refinery, Inglewood.

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B.F. Goodrich

IRON AND STEEL PRODUCTS — BASE MILL PRICES

	STRUCT. SHAPES—PLATE/	REINF. BARS billet *b,f*	RIVETS ½-in. structural/	WIRE NAILS Base *d,f*	SHEET PILING Base/	STEEL RAILS Per Net Ton: Standard	Light	Re-rolled	TRACK SUPPLIES/ Angle Bars	Std Spikes *e*	Tie Plates *e*	Track Bolts
Birmingham	$2.80	$2.75	$5.65	$4.25/5.00	....	$55.00	$62.00	Not	$3.85	$4.85	$3.65	$7.00
Chicago	2.80	2.75	5.65	4.25/5.00	$3.30	.....	.....	avail-	3.85	4.85	3.65	7.00
Pittsburgh	2.80	2.75	5.65	4.25/5.00	3.30	55.00	62.00	able	3.85	4.85	3.65	7.00
Buffalo	2.80	2.75	....	....	3.30	.....	.....	....	....	....	3.65	....
Cleveland	....	2.75	5.65	.. 4.35	....	.....	.....	....	....	....	....	....
Youngstown	....	2.75	....	....	....	.....	.....	....	....	4.85	....	....
Gulf ports	....	....	....	....	....	.....	.....	....	....	....	....	....
Geneva	2.975‡	....	....	....	....	.....	.....	....	....	....	....	....
Los Angeles	3.41/3.47‡	3.329‡	....	....	....	.....	.....	....	....	....	....	....

‡ Delivered. *b* Rail steel price upon application. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports. On tie plates alone, Steelton, Pa.; on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per CL. *e* Mill lengths. Add 50*c* for cut lengths. *f* Per 100 lbs.

IRON AND STEEL PRODUCTS — F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS/ Per 100 lb., base price *u*: 5 tons to carload lot *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH *k* Per 100 sq. yd., carload lots: Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires	SHEET PILING Per 100 lb. base price
Atlanta	$5.12‡	$5.12‡	$5.12‡	$.025	$.10	$31.00	$33.00	$2.58	$1.78	$2.71	....
Baltimore	4.71	3.97*t*	....	....	.10	33.50	35.50	2.41	1.67	2.53	....
Birmingham	4.25	4.40	4.40	.05	.15	40.00*p*	43.00*p*	2.56	1.76	2.68	....
Boston	4.67‡	4.72‡	4.19‡*c*	....	.10/.15	29.00	31.00	2.49	1.72	2.62	$3.8032*ff*
Chicago	4.40	3.50*ff*	3.50*ff*	.05	.05	27.00‡	29.00‡	2.26	1.58	2.37	3.309
Cincinnati	4.79‡	3.883*c*	3.883*c*	....	....	31.00*zee*	33.00*zee*	2.40	1.66	2.52	3.708*t*
Cleveland	4.70	3.39*x*	....	....	.10	29.00	31.00	2.36	1.63	2.47	....
Dallas	6.72	5.00	5.00	....	....	32.50	35.00	2.66	1.83	2.79	....
Denver	5.95	5.80*c*	....	....	....	40.00*s*	45.50*qs*	2.69	1.84	2.82	5.89
Detroit	4.77‡	4.58	4.58	....	.10	33.00*x*	35.00*q*	2.40	1.66	2.52	3.6512*yd*
Kansas City	5.25*ee*	4.23*uak*	4.23*uak*	....	.10	34.00	36.00	2.47	1.71	2.59	3.893*k*
Los Angeles	5.30*f*	5.10	..	....	....	39.00*fk*	45.00*fk*	2.76	1.89	2.90	4.78*f*
Minneapolis	4.83‡	5.166*ccn*	5.166*ccn*	...	.15	29.50*k*	31.50*k*	2.47	1.70	2.58	3.864*k*
Montreal	4.90*i*	4.25*i*	4.25*i*	....	....	40.28*hh*	42.98*hh*	2.54	1.75	2.66	78.70*pqq*
New Orleans	....	4.64*ok*	....	.05	.10	27.50	29.50	2.54	1.75	2.67	....
New York	4.78*r*	4.55	....	....	.15/.20	30.00*st*	32.00*st*	2.46	1.69	2.58	3.35*t*
Philadelphia	4.57	4.59	....	....	....	30.00‡	32.00‡	2.42	1.68	2.54	3.77
Pittsburgh	4.40	4.40	4.40	.05	.10	32.50	34.50	2.26	1.58	2.37	3.05
St. Louis	4.73‡	4.458*c*	4.458*c*	....	.05	38.00‡	40.00‡	2.38	1.65	2.49	....
San Francisco	5.10	4.53	....	....	....	32.50	34.50	2.76	1.89	2.90	4.85
Seattle	3.628*e*	4.43*el*	....	....	....	35.00*w*	38.50*w*	2.76	1.89	2.90	4.355*dd*

‡ Delivered. *a* Mill prices. *b* 1-5 tons, add 35c. Less than 1 ton, add 50c. *c* 20 tons or over base. *d* Mill price plus freight. *e* F.o.b. plant. *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel. *h* List price. Dominion tax exempt. Provincial and Municipal tax extra. *i* Plus Dominion, Provincial and Municipal sales tax. *j* Price per ton. *k* F.o.b. city. *l* Intermediate and hard grade, new billet. *m* Per sq. yd. *n* 5 to 8 tons base. *o* 5 to 15 tons base. *p* Del. of 5000 sq. yd. or less. *q* Std. ribbed. 4 lb. per sq. yd. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extra—1 in., 1¼ in., 1½ in. 10*c*, ¾ in., ⅞ in. 15*c*, ⅝ in. 20*c*, ½ in. 35*c*, ⅜ in. 55*c*, ¼ in. $1.30. *v* Under 20 tons. Straight. *w* Copper bearing. *x* 2.5 lb. per sq. yd. *y* $.0093 transportation tax included. *z* Copper alloy. *aa* 20 tons base. *cc* F.o.b. cars Chic. plus freight. *dd* F.o.b. dock. *ee* F.o.b. cars. *ff* Carload lots. *gg* Including sales tax.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered ASTM C13-44T: std. 8 in. s.s.	std. 12 in. s.s.	24 in.	36 in.	CLAY DRAIN TILE ASTM C4-24 Per 1,000 ft., carload lots, f.o.b.: 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTMC 14-41: 12 in.	24 in.	WROUGHT STEEL PIPE** (Full standard weight, f.o.b. destination *a*): 2½ & 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$85.84	$0.43	$0.67	$3.39	$7.00	$114.00	$140.00	$0.45	$2.00	47.2	31.2	42.2	25.7
Baltimore	90.02	.378	.729	3.105	8.098	147.00	228.00	.80	2.20	50.9	34.9	45.9	29.4
Birmingham	79.50	.375	.675	3.06	....	210.00‡	375.00‡	.75	2.00	47.2	31.2	42.2	25.7
Boston	93.14	392*usz*	.756*usz*	3.465*usy*	8.7125*usy*	150.60	233.40	1.03*ycc*	2.75*ycc*	49.2	33.2	44.2	27.7
Chicago	92.17	54	1.08	4.12	12.80	150.00‡	270.00‡	.65	2.25	53.0*t*	37.0*t*	47.0*t*	30.5
Cincinnati	90.73	406	.783	4.00	12.00	155.00‡	240.00‡	.60	2.25	51.4	35.4	46.4	29.9*t*
Cleveland	92.74	.336*x*	.648*x*	2.88*x*	8.0975*x*	141.50	221.00	.58	2.25	53.7	37.7	48.7	32.2
Dallas	94.48	375	.675	2.70	6.20	109.00	131.00	.45	1.45	45.3	29.3	40.3	23.8
Denver	99.32	.40*dd*	.71*dd*	2.98*dd*	....	.....	.....	.74*dd*	2.50*dd*	43.4	27.4	38.2	21.7
Detroit	92.74	.51	.98	4.31	10.79	170.00‡*m*	260.00‡*m*	.50	1.90	51.9	35.9	46.9	30.4
Kansas City	93.82	.39*m*	.705*m*	2.78*m*	7.15*m*	180.00*m*	310.00*m*	.50*t*	1.70*t*	48.7	32.7	43.3	26.8
Los Angeles	105.70	.414	.894	4.347	10.868	220.00‡	360.00‡	.65	...	....	....	....	....
Minneapolis	95.80	.55*mo*	1.05*mo*	4.10*mo*	....	.....	.....	1.19*h*	3.18*h*	48.8	32.8	43.4	26.9
Montreal	78.20	.73*s*	1.28*s*	4.20*s*	6.80*es*	.60*paa*	.48*paa*	72.00*jkaa*	218.00*jkhaa*	....	....	....	....
New Orleans	88.72	.412	.762	3.955	9.15	231.00*bb*	.....	.55	1.95	46.8	30.8	41.8	25.3
New York	89.06	.62	1.14	4.39	11.20	.....	.....	1.00	2.25	50.2	34.2	45.2	28.7
Philadelphia	87.14	.50	.95	3.95	9.75	220.00‡	275.00‡	1.05*h*	2.75*h*	50.7	34.7	45.7	29.2
Pittsburgh	93.22	.364*m*	.702*m*	2.70*m*	6.625*m*	130.20	197.40	1.05*h*	2.50*g*	54.0*t*	37.0*t*	49.0*t*	32.5*t*
St. Louis	90.16	.40	.72	2.88	6.53	.....	.....	1.10*il*	2.15*hl**	50.6	34.6	44.7	28.2
San Francisco	105.70	.438*d*	.878*d*	3.69*d*	9.23*d*	169.00*dl*	282.00*dl*	.69	2.85	....	....	....	....
Seattle	107.50	.45*b*	.81*b*	....	....	72.50*c*	.....	.595	1.80	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, CL, Burlington, N. J. (base) $84.50. Based on existing freight rates; subject to rate change. *b* Cast pipe and class A, $5 per ton additional. 4 in., $5 per ton additional. 30 in. and larger, usually $1 per ton less. *b* Extra strength ASTM C 200-44T. *c* 4 in. *d* SS361-A. *e* 30 in. *g* Culvert pipe. Reinforced, ASTM C76-41. *h* Reinforced. ASTM C75-41. *i* Reinforced. ASTM C76-37. *j* Centrispun. *k* Per 100 ft. *l* F.o.b. plant. *m* Truck delivery. *o* Listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per ft. *s* Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: ¼ in., 8½c.; ⅜ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. *u* ASTM C13-40. *v* F.o.b. city *x* 2 ft. lengths. *y* 3 ft. lengths. *z* CESA A60-1941 specifications used.. *aa* No standard specifications in Can. *bb* Freight allowed to destinations in city. *cc* Truck loads; f.o.b. plant, Newton. *dd* LCL. delivered, f.o.b. truck. ** Recent 20% emergency freight rate increment granted railroads on Jan. 5 not included. * Correction: Dec.-Feb. price, $2.25 was delivered. Corresponding f.o.b. plant price, $2.15.

WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt weld — 1 in. and 1¼ in. black, 34 galv., 16; 1½ in. black, 38 galv., 18½; 2 in. black, 37½, galv., 18. Lap weld — 2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment* (See note for base price)	
	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	5/16"	1/4"
Atlanta	**$80.00**	**$82.00**	**$70.00**	**$70.00**	**$75.00**	**$76.00**	**$80.00**	.....	.....	.....	.....	**$22.32**	**$27.24**
	95.00	*95.00*	*96.50*	*96.50*	*96.50*	*96.50*	*87.50*	*$87.50*	*$87.50*	.....	.....	.....	.....
Baltimore	**96.00**	**96.00**	**96.00**	**95.00**	**100.00**	**104.00**	**115.00**	.....	.....	193.60	182.00	22.86	27.90
	106.00	*108.00*	*112.80*	*112.00*	*114.00*	*114.00*	*121.00*	*121.00*	*121.00*	.....	.....	.....	.....
Birmingham	**90.50**	**90.50**	**87.00**	**86.00**	**87.00**	**90.00**	**110.00**	.....	.....	120.00	117.50	21.78	26.58
	95.50	*95.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*102.00*	*105.00*	.....	.....	.....	.....
Boston	88.00[3]	90.00[3]	88.00[3]	88.50[3]	90.00[3]	93.00[3]	100.00[3]	.....	.....	.....	.....	**22.86**	**27.90**
	§ *95.00*	*95.00*	*95.00*	*95.00*	*95.00*	*95.00*	*105.00*	*105.00*	*105.00*	105.00	105.00	.....	.....
Chicago	‡ **100.00**	**104.00**	**93.00**	**93.00**	**100.00**	**100.00**	**100.00**	.....	.....	125.00	125.00	18.72	22.80
	‡ *108.00*	*108.00*	*100.00*	*100.00*	*100.00*	*105.00*	*105.00*	*105.00*	*105.00*	.....	.....	.....	.....
Cincinnati	*n* **100.00**	**100.00**	**95.00**	**95.00**	**95.00**	**95.00**	**130.00**	.....	.....	120.00	.....	21.78	26.58
Cleveland	*k* **110.00**	**120.00**	**120.00**	**120.00**	**120.00**	**125.00**	**130.00**	.....	.....	130.00	130.00	22.20	27.12
	k 115.00	*130.00*	*130.00*	*130.00*	*130.00*	*130.00*	*130.00*	*130.00*	*130.00*	.....	.....	.....	.....
Dallas	*l* **71.00**	**71.00**	**61.00**	**59.00**	**61.00**	**66.00**	**80.00**	.....	.....	72.00	80.00	18.72	22.80
Denver	*101.00*	*100.00*	*97.00*	*94.50*	*94.00*	*95.50*	*97.00*	*104.50*	*108.50*	.....	.....	13.92	16.98
Detroit	**98.00**	**98.00**	**90.00**	**90.00**	**95.00**	**93.00**	**93.00**	.....	.....	90.00	105.00	21.78	26.58
	98.00	*98.00*	*92.00*	*92.00*	*98.00*	*95.00*	*100.00*	*100.00*	*105.00*	.....	.....	.....	.....
Kansas City	*am* **105.00**	**110.00**	**100.00**	**100.00**	**100.00**	**100.00**	.....	.....	.....	.....	.....	16.56	20.16
	105.00	*110.00*	*100.00*	*100.00*	*100.00*	*100.00*	*105.00*	*120.00*	*120.00*	.....	.....	.....	.....
Los Angeles	*a 108.00*	*108.00*	*108.00*	*108.00*	*108.00*	*108.00*	*107.00*	*117.00*	*107.00*	.....	.....	13.38*gA*	16.26*gA*
Minneapolis	‡*b* 112.00[8]	112.00[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.56	20.16
	‡*b 108.00*	*108.00*	*108.00*	*108.00*	*108.00*	*110.00*	*130.00*	*130.00*	*130.00*	.....	.....	.....	.....
Montreal	*e* **73.00**	**76.00**	**70.00**	**72.00**	**76.00**	**85.00**	.....	.....	.....	.....	.....	.....	.....
	111.55	*111.55*	*111.55*	*111.55*	*111.55*	*111.55*	*129.00*	*87.00*	.....	.....	.....	.....	.....
New Orleans	*l* **80.00**	**90.00**	**75.00**	**80.00**	**80.00**	**77.00**	**85.00**	.....	.....	.....	.....	18.72	22.80
	l 68.00	*68.00*	*70.00*	*67.00*	*67.00*	*67.00*	*71.00*	.....	.....	.....	.....	.....	.....
New York	‡ **105/110**	**105/110**	**Range from $95.00 to $100.00**				**115/120**			175.00†	175.00†	22.86	27.90
	‡	.....	*Range from $115.00 to $120.00*				*120/125*	*120/125*	*120/125*	.....	.....	.....	.....
Philadelphia			**Range from $100.00 to $110.00**				**100/110**			150.00	150.00	22.86	27.90
			Range from $110.00 to $120.00				*110/120*	*110/120*	*110/120*	.....	.....	.....	.....
Pittsburgh	**75.00**	**77.00**	**80.10**	**80.10**	**83.25**	**89.70**	**107.75**	.....	.....	130.60	141.00	22.56	27.48
	93.60	*93.60*	*88.00*	*88.00*	*87.00*	*91.00*	*110.00*	*116.00*	*118.00*	.....	.....	.....	.....
St. Louis	‡*j* **110.00**	**110.00**	**115.00**	**109.00**	**110.00**	**113.00**	.....	.....	.....	.....	.....	18.72	22.80
	‡*j 120.00*	*120.00*	*130.00*	*130.00*	*130.00*	*130.00*	*135.00*	*145.00*	*145.00*	.....	.....	.....	.....
San Francisco	*d 76.50*	*76.50*	*76.50*	*76.50*	*76.50*	*74.50*	*74.00*	*74.00*	*74.00*	.....	.....	10.08*g*	12.30*g*
Seattle	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*75.00i*	*75.00i*	*75.00i*	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [3] Spruce. [8] Western Pine, No. 3 Common. [1] Norway Pine. ‡Delivered. *a* Yard prices. *b* Retail prices, less than CL. *c* 5 M ft. or less. *d* Sales through wholesale distribution yard (F.o.b. purchaser's truck or carrier, San Francisco paid). *e* Tax exempt. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* No. 1 common. *j* Delivered in 5000 ft. lots. *k* These are retail yard prices quoted per truckload in Greater Cleveland. Less 2% for cash. Truck lots. *l* F.o.b. mill. *m* LCL. *n* Mar. price in effect since Jan. 1948.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on 1/2", $174.00; on 1/4", $200.00. For other centers add rail freight increment from table on proper size. For oiling add $3.00; for edge sealing add $2.00; for resin sealing add $8.50.

* Freight rates include 20% emergency increase granted railroads on Jan. 5.

† 18 ft. and under. § No. 2 com. comparable to No. 1 previously quoted. Mar. prices in effect since Jan. 1948. Previous prices were Dec. 1946 prices.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Jan. 16, 1946 Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	76%	76%	$0.195
Baltimore	70–10%	71–10%	.195
Birmingham	68%	68%	.15
Boston	77%	78%	.195
Chicago	68%*e*	68%*e*	.195
Cincinnati	67–6%*a*	67–6%*a*	.195
Cleveland	67–10–10%	67–10–10–10%	.235
Dallas	67%*e*	68%*e*	.2075
Denver	68%	68%	.20
Detroit	77%	76%	.195
Kansas City	68-10%*g*	68-10%*g*	.20
Los Angeles	63%	68%*h*	.2025
Minneapolis	68%	68%	.20
Montreal	40–5%*ab*	40–10–5%*ab*	18.25*i*
New Orleans	68%	68%	.205
New York	73%	74%	.265*f*
Philadelphia	69%	70%	.195
Pittsburgh	70–10%	70–10%	.1675
St. Louis	70–10%	70–10%	.20
San Francisco	66%	73%	.20
Seattle	57%	58%	.2025

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

a Discount from list, Sept., 1939; all now tax exempt. *b* Single thickness. *e* Discount from list of Jan. 29, 1947. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $9.00 per trip. *g* Discount from list of Aug 15, 1938. *h* Single thickness. Double thickness, 67%. *i* F.o.b. city per 100 lb. forcite, 40%; 60%, $20.00.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.15	$0.175	$0.195
W. of Miss. to Rocky Mtn. States, Fla. and Maine.	.155 –.1625	.18 –.1925	.20 –.2125
Rocky Mtn. States	.155 –.1675	.18 –.1975	.20 –.2175
Pacific N. W. States	.1525–.165	.1825–.195	.2025–.215
Pacific S. W. States	.15 –.1575	.18 –.1875	.20 –.21

PILES, TIES F. O. B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail Pine*	By Rail Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	....
12-in.—2-ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.—2-ft. from butt	6-in.	60 to 69-ft.	.36	....
12-in.—2-ft. from butt	6-in.	90 to 100-ft.	....	.62
13-in.—3-ft. from butt	5-in.	91 to 100-ft.	....	.63
14-in.—2-ft. from butt	6-in.	50 to 69-ft.	.41	.70
14-in.—2-ft. from butt	6-in.	70 to 79-ft.	.43	.64
14-in.—2-ft. from butt	5-in	80 to 85-ft.	.54	.65
14-in.—2-ft. from butt	5-in.	85 to 89-ft.	.57	.66
14-in.—2-ft. from butt	5-in.	90 to 100-ft.	....	.70

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.45	.....	$2.00	.....
	Pine	1.35	$3.05*a*	1.90	$4.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.35/2.45*a*	....	3.25/3.40*a*
Los Angeles	Douglas Fir	1.86	2.82*a*	....	....
Philadelphia	Red Oak	2.33	3.13*a*	3.10	4.25*a*
St. Louis	White Oak	1.75	....	2.40	....
	Red Oak	....	2.37*a*	....	3.45*a*
	Sap Pine or Cypress	2.17*a*	....	....	....
San Francisco	Douglas Fir	1.60*ef*	2.80*f*	2.10*bf*	3.88*caf*
Montreal	Birch or Maple	.... *h*	.... *h*	.... *h*	.... *h*

Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 7" x 9" x 8'. *c* Empty cell. *e* Green. *f* F.o.b. cars. *h* No constant price available.

CHEMICALS

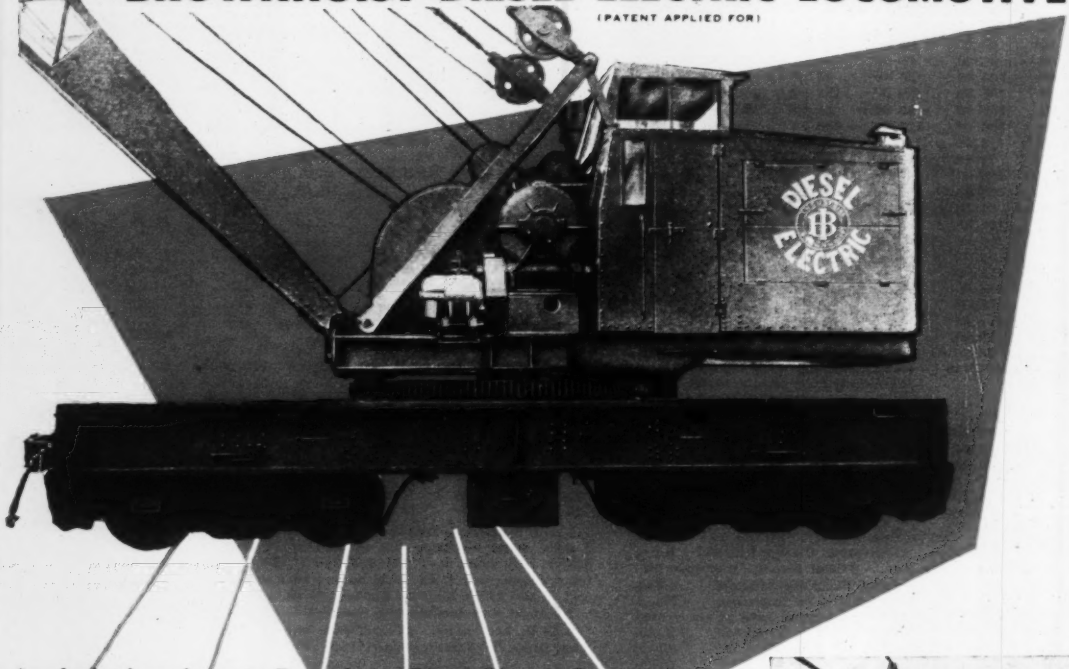
Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100 lb.	$3.75
Chlorine cylinders, liquid, per lb. f.o.b. works	.07–.12
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, f.o.b. works, ton	22.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.65
Soda ash, 58%, in paper bags, per 100 lb. dense	1.38
Sulphate of aluminum, commercial, in 100-lb. bags f.o.b. works	1.15–1.30
Sulphate of copper, in bags, per 100 lb f.o.b. works	7.60

electric travel reduces maintenance costs of new

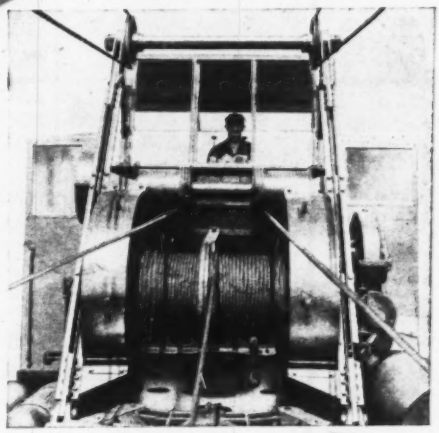
BROWNHOIST DIESEL ELECTRIC LOCOMOTIVE-CRANE

(PATENT APPLIED FOR)



In designing the new Brownhoist Diesel Electric Locomotive-Crane for double duty as a powerful crane and switch engine, Brownhoist engineers had two prime objectives: to increase operating efficiency and reduce maintenance costs. The new Brownhoist Diesel Electric supplies *travel power directly to the axles from two oversize spring-mounted motors hung inside the AAR cast steel side frame trucks. Power for hoist, swing, and booming is transmitted through a helical gear reducer.* Simple, efficient, trouble-free!

These are only two of the many *money-saving, labor-saving, time-saving* features engineered into the Brownhoist Diesel Electric Locomotive-Crane. Others include the patented Monitor-type cab that affords the operator 360° visibility—travel speeds up to 15 M.P.H.—double disc roller bearing mounted rotating clutches —roller bearing boom tip sheaves—14″ safety clearance between car body and rotating bed—safe worm driven boom hoist. Capacities 30 tons and up. Write for complete facts that will show you how to *speed and simplify your material handling at lower costs.*



This view shows how the electric travel reduces the crane crab mechanism to a minimum with only **three** widely spaced horizontal shafts accessible from all sides. Note the 360° vision Monitor-type cab with hoist and boom hoist drums in full view of operator.

BROWNHOIST BUILDS BETTER CRANES

INDUSTRIAL BROWNHOIST CORPORATION • BAY CITY, MICHIGAN

DISTRICT OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO • **AGENCIES:** DETROIT, BIRMINGHAM, HOUSTON, LOS ANGELES, PORTLAND, SAN FRANCISCO, SEATTLE, SPOKANE, CANADIAN BROWNHOIST LTD., MONTREAL, QUEBEC.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over. 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over. 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity Common backing	Straight hard	LIME Per ton. In paper. Carload lot. Hydrated finishing	Common hydrated	Pulverized or lump
Atlanta	.....	.....	.....	.....	.....	.....	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	$120.00	$126.00	$220.00	$240.00	$315.00	$340.00	31.00*k*	33.00*k*	30.00	18.00	.....
Birmingham	97.50	104.00	195.00	231.00	.....	.....	20.00*jf*	22.50*kp*	23.55	17.50	.....
Boston	105.00†	112.00†	210.00†	252.09†	.....	.....	20.00*k*	20.00*k*	21.00†	.....	16.00
Chicago	115.00	122.50	230.00	.....	.....	.....	20.00	21.00	25.00	18.00	.....
Cincinnati	120.00*j*	135.00*j*	170.00*jdd*	280.00*y*	.....	.....	33.00	33.00	25.60	23.20	.....
Cleveland	113.50*cc*	121.00*cc*	222.50*cc*	.....	.....	.....	27.50	27.50	21.45	19.45	23.55*ea*
Dallas	.....	106.00*	.....	.....	.....	.....	18.00	20.00	28.00	22.00	.....
Denver	.....	.....	.....	.....	.....	.....	28.50	28.50‡	34.80*bb*	28.00*bb*	34.00*bb*
Detroit	130.00	145.00	260.00	300.00	380.00	443.00	27.00*cc*	29.00*cc*	28.00	26.00	26.00
Kansas City	112.00	120.00	.....	.....	.....	.....	16.00*o*	18.50*o*	34.00*p*	30.00*p*	30.00*p*
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	20.00§	.....	33.20	33.20	27.00
Minneapolis	162.10*p*	187.00*p*	334.30*p*	187.00*ep*	.....	.....	27.00*p*	.....	33.50*bbe*	24.50*bbe*	33.50*bbde*
Montreal	100.00*aq*	110.00*aq*	206.25*aq*	151.50*aaq*	.....	294.40*aq*	24.00	35.00	12.50*au*	14.00*au*	18.45*u*
New Orleans	160.00	160.00	300.00	.....	.....	.....	29.00	.....	30.00	20.00	.....
New York	103.90	110.80	152.35*c*	166.70*hn*	.....	.....	29.00	..	34.00	25.90	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	26.00	29.00	29.75	17.50	.....
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	26.00	31.00*y*	20.45	18.65	2.97*m*
St. Louis	113.00	118.00	220.00	231.50	275.00	.....	28.50*al*	26.50*al*	.72*aap*	.55*aap*	.82*aaspee*
San Francisco	124.00*a*	139.50*a*	186.00*dda*	139.50*a*	.....	.....	27.50	.....	24.65	24.65	2.46*m*
Seattle	137.00*cc*	147.00*cc*	.....	147.00*ccw*	.....	.....	28.50	33.50	32.00*hh*	32.00*hh*	3.60*mhh*

† F.o.b. *a* Smooth. *b* Per 50 lb. bags. *c* 6 x 12 x 12 in.-3 cell. *d* Pulverized hot. *e* 5% discount for cash. *g* 5½ x 8 x 12. *h* F.o.b. trucks, job site N.Y.C. *i* F.o.b. warehouse only. *j* Truck load or over. *k* $1.00 discount. *l* Red face. *m* Per bbl., 180 lb. *n* 7⅛ x 7⅛ x 12. Speed title. *o* F.o.b. Buffalo. *p* Truck lots. *q* Provincial and Municipal tax extra. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5½ x 8 x 11¼. *u* Tax exempt. *v* Sand lime. *w* 5 x 8 x 12. *y* Stacked. *z* Pebble lime price per 80 lb. sack. *aa* Price per sack. Lime not sold per ton. *bb* LCL. *cc* Truck delivery. *dd* 6 x 12 x 12. *ee* Pebble lime. *ff* 80% common. *gg* Select. *hh* LCL. * Correction: Jan.-Feb. price, $97. ‡ Comparable July-Dec. price, $27.50. § F.o.b. plant. Comparable plant price from Aug. 1947 Feb. 1948 was $20. Feb. price was del.

PAINT, ROOFING — F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl Dry *a*	WHITE LEAD Per 100 lb. in 100 lb. cases In oil *w*	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$18.85	$27.375	$1.75	$2.70	$1.65	$2.06‡	$2.06‡	$2.06‡	$1.90‡	$36.00‡
Baltimore	18.60	27.00	2.25	3.50	2.75	2.75	3.30	3.30	.55	33.00
Birmingham	18.85	27.375	4.40	4.52	....	3.05	3.00	3.00	.48	34.50
Boston	18.60	27.00	1.75	2.50	2.31	2.00‡*h*	3.30‡*q*	3.30‡*q*	.25‡	21.00
Chicago	18.60	27.00	....	....	....	2.78‡*u*	2.91‡*o*	2.91‡*o*	34.00‡*bb*	35.00‡
Cincinnati	18.60	27.00	....	3.15	1.90	2.39	2.50*o*	2.50*o*	....	40.00
Cleveland	18.60	27.00	3.00	3.00*s*	3.00	2.39	2.50*o*	2.50*o*	.32*y*	35.40
Dallas	18.60	27.00	....	4.05	....	2.69*q*	3.00*t*	3.15*q*	.90	45.00
Denver	18.60	27.50	2.88	4.38	2.63	3.17*o*	3.09*o*	.....	.46*	40.00
Detroit	18.60	27.00	2.25	3.00	2.00	2.25	2.25	2.25	.50	25.00
Kansas City	18.60	27.125	3.30*g*	3.55*g*	3.16*g*	3.00	3.25	3.50	.54	31.00
Los Angeles	18.85	27.50	2.80	4.00	3.50	2.35	1.80*x*	*l*	.65	*l*
Minneapolis	18.60	26.88*m*	....	....	....	2.27*idd*	2.38*hidd*	2.38*hidd*	42*idd*	30.00*vdd*
Montreal	.....	19.20	2.90*p*	4.20*p*	3.62*p*	3.14*t*	2.85*tf*	2.30*tf*	.68*t*	2.15*kt*
New York	18.60	27.00	3.45*y*	....	3.45*y*	2.28	2.38*o*	2.38*o*	.34*s*	33.00
Philadelphia	18.60	27.00	3.00	3.40	2.90	2.54	2.94	2.94	.37	26.00
Pittsburgh	18.60	27.00	2.00	2.90	1.90	2.98	3.00*o*	3.00*o*	.37	35.00
St. Louis	18.60	27.00	....	....	....	2.75	2.83	2.83	.40	33.00
San Francisco	18.85	27.25	1.80	2.75*n*	1.35	2.27*x*	3.30*aa*	....	.38*y*	.....
Seattle	18.85	27.50	2.95*m*	2.95*m*	....	3.25*mqcc*	3.35*hmcc*	....	.49*mcc*	46.75*jmcc*

‡ Delivered Note: Red lead in oil 50¢ higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* 15 lb. *f* Per 432 sq. ft. *g* 50 gal. drums. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per cwt. *l* Not used. *m* 1% discount for cash. *n* May, 1941 price. *o* Per 60-lb. roll. *p* Tax included. *q* Per 90-lb. roll. *r* F.o.b. factory Chicago. *s* ASTM Spec. D266-41. *t* Federal tax included. *u* Per 90 lb. square. *v* Per ton. *w* Price to large paint contractors is $1.25 less. *x* Mineral surfaced. *y* 55-gallon container. *z* Drums. *aa* Approximate cost per 100 lbs. *bb* Roofers coating and cement. Price per ton. *cc* LCL, truck delivery. *dd* 2% cash discount * Correction: Comparable Feb. price for 5-gal. drums, 46¢.

SKILLED AND COMMON WAGE RATES — PER HOUR

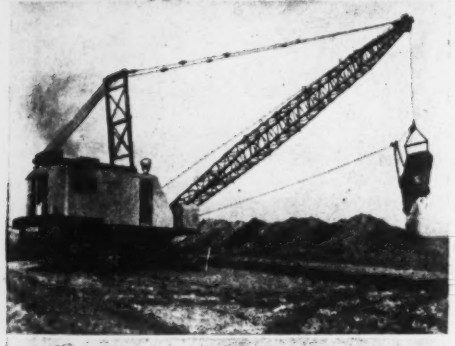
	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Electrical Workers	Steamfitters	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.25	$1.65	$2.00	$2.00	$2.00	$2.00	$2.00	$0.75	$0.85
Baltimore	2.50	1.95	2.15	2.20/2.40	2.00	2.00	2.00	1.10	1.10
Birmingham	2.25	1.625	1.90	1.60/1.875	2.00	2.00	2.00	.85	.95
Boston	2.15	1.90	2.15	2.25	2.25	2.15	2.00	1.40	1.40
Chicago	2.20	2.15	2.20	2.15	2.225	2.15	2.15	1.50	1.50
Cincinnati	2.25	1.975	2.10	2.00	2.125	2.125	2.125	1.25	1.15
Cleveland	2.25	2.125	2.25	1.875/2.125	2.125	2.125	2.125	1.55	1.40
Dallas	2.25	1.875	2.00	2.00	2.125	2.00	2.125	.95	.95/1.50
Denver	2.25*b*	1.875	1.875*b*	1.875*b*	2.25	2.05	2.05	1.275	1.35
Detroit	2.25	2.025	2.25	2.25	2.25	2.25	2.165	1.425	1.425
Kansas City	2.25	1.90	2.05	1.90/2.125	2.25	2.15	2.125	1.35	1.40
Los Angeles	2.375	1.90	2.10	1.85	2.25	2.25	2.25	1.35	1.35
Minneapolis	2.075	1.80	2.00	1.85	2.25	2.06	2.00	1.30	1.30
New Orleans	1.9375	1.70	2.00	1.75	1.875	2.00	2.05	.90	.90
New York	2.75*b*	2.75*b*	3.00	3.00	3.00*a*	2.50*a*	2.75*b*	1.50	1.50
Philadelphia	2.40/2.50	2.00	2.40	2.25	2.25	2.25	2.25	1.10	1.10
Pittsburgh	2.50	2.25	2.25	2.40	2.25	2.25	2.25	1.30	1.30
St. Louis	2.50	2.20	2.25	2.40	2.25	2.25	2.25	1.35	1.75
San Francisco	2.25	2.00	2.25	2.00	2.25	2.25	2.25	1.40	1.40
Seattle	2.365	2.065	2.265	2.20	2.365	2.265	2.34	1.665	1.70
Montreal*	1.40	1.06	1.11	1.00	1.17	1.11	1.11	.73	.67

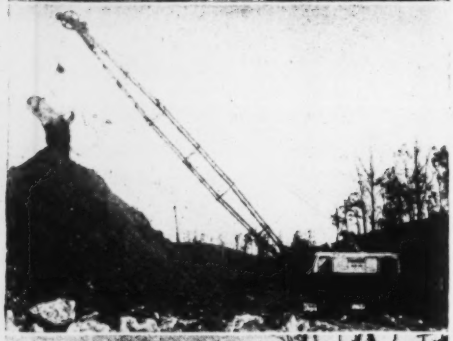
a 6 hr day. *b* 7 hr day. * Cost of living bonus now included in basic wage.

MEXICO CITY PRICES

In Pesos, F.o.b. City		Jan. '48	Feb. '48
Common Wages—Building (8 hr. day)	av. per hr.	.57	.57
Common Wages—Heavy Const. (8 hr. day)	av. per hr.	.75	.75
Skilled Labor Wages			
Carpenters (8 hr. day)	av. per hr.	1.25	1.25
Bricklayers (8 hr. day)	av. per hr.	1.25	1.25
Struct. Iron Workers (8 hr. day)	av. per hr.	1.50	1.50
Struct. Steel Shapes			
3"-15" x 12 meters	per ton	800.00	800.00
Reinf. Steel, Corr. Rods			
⅜" x 12 meters	per ton	1,000.00	1,000.00
½" x 12 meters	per ton	975.00	975.00
⅝" x 12 meters	per ton	940.00	940.00
¾" x 12 meters	per ton	940.00	940.00
⅞" x 12 meters	per ton	930.00	930.00
1" x 12 meters	per ton	925.00	925.00
Gravel, truck load of 3½ cu. meters			
Blue Gravel	per tr. load	32.00	32.00
Rose Gravel	per tr. load	30.00	28.00
Cement, Std. Port. (Tolteca)	per ton	115.00	115.00
Lumber			
Mex. Sacred Fir (Oyamel)	per M ft.	400.00	400.00
1st Class Pine	per M ft.	750.00	750.00
2nd Class Pine	per M ft.	500.00	500.00

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $2.153. **ENR Common Average:** $1.283





Save with MARIONS

There is a MARION to save you Time and Money on every job

Modern features of design, plus sound engineering throughout, have made MARION shovels and draglines top performers in the handling of materials on construction projects of all kinds. They have the speed, power and the stamina to STAY ON THE JOB without let-up . . . and to handle capacity yardage in record time. They are real money makers for every owner.

THE MARION LINE

GASOLINE • • • DIESELS • • • ELECTRIC

Model	*Capacity*	*Model*	*Capacity*
33-M . . .	¾ cu. yds.	151-M	6 cu. yds.
362	1½ cu. yds.	*7200 Walker . .	5-7 cu. yds.
93-M . . .	2½ cu. yds.	*7400 Walker	8-12 cu. yds.
111-M .	3½-4 cu. yds.	*7800 Walker	15-30 cu. yds.
492	3 cu. yds.	*Size of dragline bucket	
4161	5 cu. yds.	depends on length of boom.	

What is your material handling problem?

MARION

POWER SHOVEL COMPANY

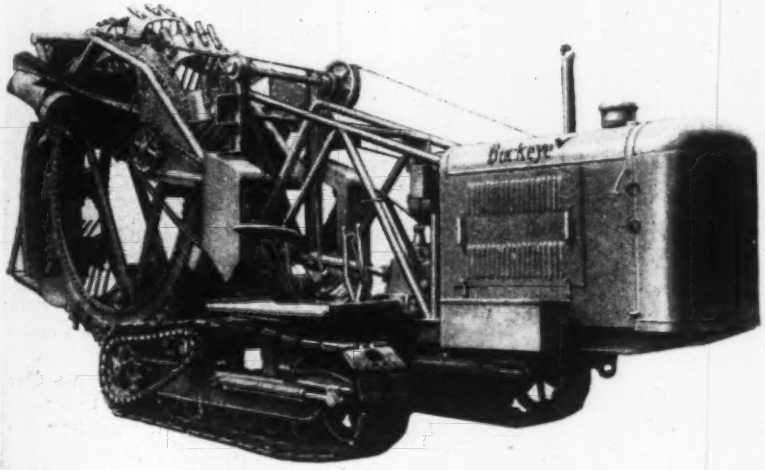
MARION, OHIO, U. S. A.

Offices and Warehouses in all Principal Cities

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

(Number refers to item directly below it)

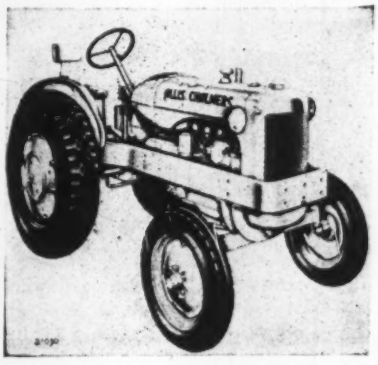


165

NEW DITCHER—The Buckeye model 312 ditcher illustrated has been subjected to prolonged field tests, proving that it offers greater range, simplified controls and better balance. This model cuts a ditch 16 in. to 30 in. wide, depending upon the buckets used, and up to 6 ft. deep. The digging wheel is supported by a rugged frame of tubular members. Its diesel engine develops 67 hp at 1,600 rpm. Digging speeds up to 57.5 ft. per minute. It has four forward and four reverse road speeds.—*Gar Wood Industries, Inc., Findlay, Ohio.*

166

WHEEL TRACTOR—New 1948 model wheel tractor designed for municipal and industrial maintenance. Weight of 16.3-hp unit is 2365 lb. Rugged steel frame provides easy mounting for a



wide assortment of tools such as snow plows, brooms, hoists and mowers. Powered by water-cooled 4-cycle gasoline engine, tractor has wheelbase of 57⅞ in., length of 97½ in., and ground clearance under front axle of 8¾ in.—*Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee* 1.

167

CARRYING CASE—Welding or cutting outfit, including torch, tips, regulators, hose, gloves, goggles, and miscellaneous equipment, can be compactly arranged in new case of 22-gage cold rolled steel with flush double lock seams. Reinforced ends and cover are paneled for rigidity and strength. It weighs 10½ lb., and is 8 in. wide, 22 in. long, and 9 in. deep.—*Air Reduction Sales Co., 60 E. 42nd St., New York* 17, *N. Y.*

168

ELECTRODE — New Hydrogen free, mineral type, extrusion coated electrodes range in diameter from ¼ to ⅛ in. and are recommended for use with d.c. reverse polarity and alternating current. Application of Flexarc LoH electrode is typified by quiet arc action and absence of usual spatter.—*Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.*

169

LIFTING GRIP—Granny-Grips are designed for handling open top containers, sheet stock, boiler plate and other materials. Jaws operate on eccentric principle whereby the heavier the load being applied, the tighter the grip. Made in single-strand and double-strand construction, both with a throat capacity up to 1 in. Single-strand unit tests to 7,850 lb. and weighs 13 lb. Overall length 29½ in.—*Industrial Products Co., 2715 No. 4th St., Philadelphia 33, Pa.*

170

IMPROVED PULLER — New ¾ ton model weighing 13 lb. lifts and pulls from any angle. Number of teeth in brake and lever ratchets has been increased to permit accurate spotting of

loads. Up and down button has been replaced by trigger on handle to permit more convenient one-hand operation. Oil-impregnated bronze bushings are used at all rotating points. Gears are packed with grease and sealed in dust-proof enclosure. New pullers are

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Company _____

Address _____

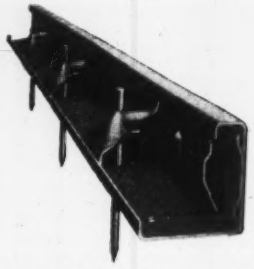
_____

"SOME BIG CONSTRUCTION JOB GOING ON DOWN THERE"

"YEAH! GOOD JOB, TOO! THEY'RE USING

HELTZEL
STEEL FORMS

Airport, highway, sidewalk, curb and gutter, or whatever job it might be, there are sure to be Heltzel Steel Forms in the picture. You depend on Heltzel because their concentrated engineering has worked every detail to practical purpose. Each exclusive feature added has eliminated another problem for you.



Heltzel Standard 1/4" Form

The same practical engineering that designed the special dual duty forms for the Patterson Field job is found in every Heltzel Steel Form. The standard form (illustrated above) is built to last, handle easily, and produce a better job. Moved from job to job, year in and year out, they set quickly, interlock smoothly, and strip away easily. They stay rigid because THE SINGLE WEDGE POCKET HOLDS STAKES FIRM—they can't vibrate loose.

Special Heltzel dual duty forms at Patterson Field carried the heaviest construction equipment ever supported by any forms. The same set of forms were used for both 21" and 25" slabs.

Heltzel Steel Form & Iron Company, Warren, Ohio

Send me the following:

[ ] B-19 Steel Highway and Airport Forms
[ ] B-19A Steel Dual Duty Airport Forms
[ ] A-20 Steel Forms for Curbs or Curb and Gutters or Sidewalks.

Name _____

Address _____

City _____ State _____

(Type of construction usually engaged in)

Heltzel
BUILDS IT BETTER

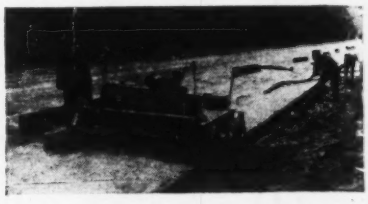
- BINS, Portable and Stationary
- CEMENT BINS, Portable and Stationary
- CENTRAL MIXING PLANTS
- BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)
- ROAD FORMS (with lip curb and integral curb attachments)
- CURB FORMS
- CURB AND GUTTER FORMS
- SIDEWALK FORMS
- CONCRETE BUCKETS
- TOOL BOXES
- FINISHING TOOLS FOR CONCRETE ROADS

HELTZEL STEEL FORM & IRON CO.
WARREN, OHIO · U. S. A.

available in ¾, 1½, 3 and 6-ton capacities. — *Chisholm-Moore Hoist Corp., Tonawanda, N. Y.*

171

WIDENING FINISHER — Machine is of single screed type with widths adjustable from 2 to 6 ft. by changing screed wings. Has automotive type



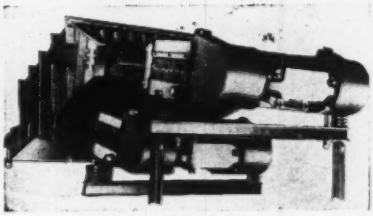
transmission with all parts running in oil and oversized ball bearing clutch. One forward traction speed for normal work and one high reverse speed. Machine has two screed speeds to accommodate concrete of different textures. —*Blaw-Knox Co., Pittsburgh, Pa.*

172

NEW WELDING ELECTRODE—For welding mild steel, new Airco No. 387 has characteristics which include the following: bead is smooth and of proper contour. Excellent operating characteristics on small ac or small dc current. Minimum of spatter is produced. Operates in all positions. Available in ⅛, 5/32, 3/16 and ¼ in. diameters. —*Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.*

173

VIBRATORY GRIZZLY FEEDER—Designed for large capacity separation of crusher feeds, heavy duty elec-



tric vibratory grizzly is equipped with double magnet. Variable control of rate of feed. Operation is from 220 or 440 volts a.c. Small models operate from 110 volts a.c.—*Syntron Co., 500 Lexington, Homer, Pa.*

174

COVER FOR AIR HOSE—New hose cover utilizes a cushioning stock similar to that developed for tire threads. Softness of heavy gage stock affords maximum resistance to extreme abrasion and gouging. Hose is reinforced with a cabled cotton body for greater carcass strength and flexibility. Seamless tube is unaffected by lubricants. Manufactured in two types—two-braid standard for pneumatic tool service and

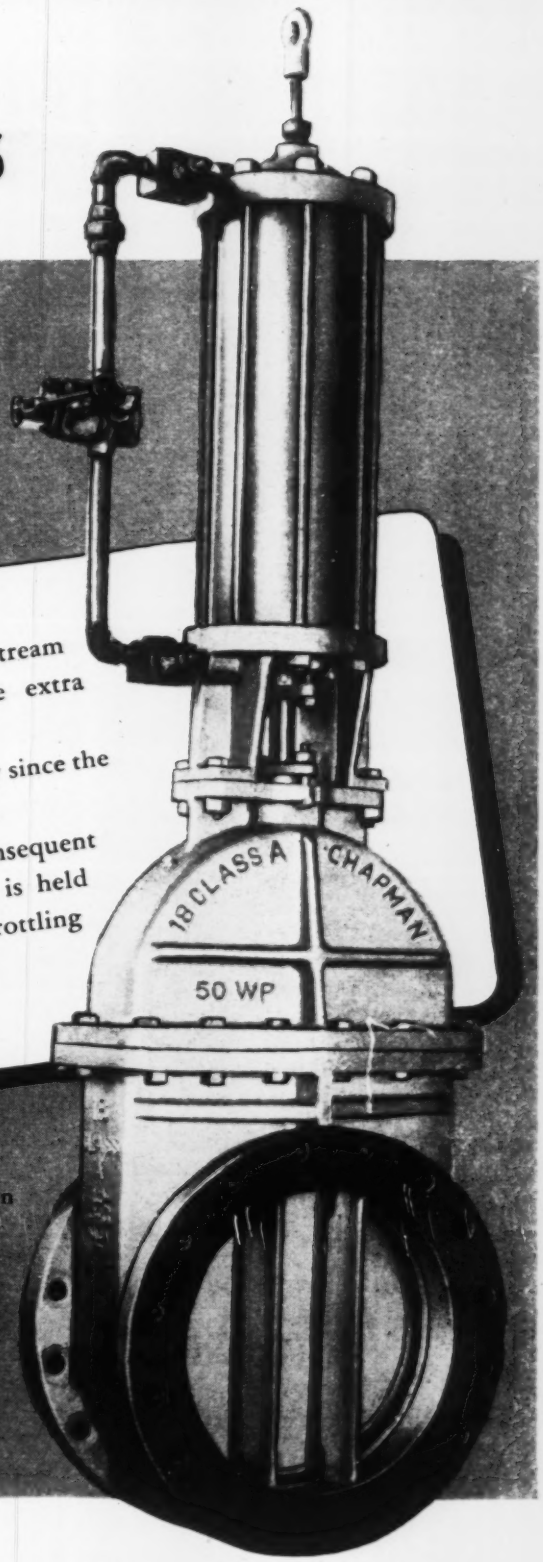
You Get These SPECIAL FEATURES

in

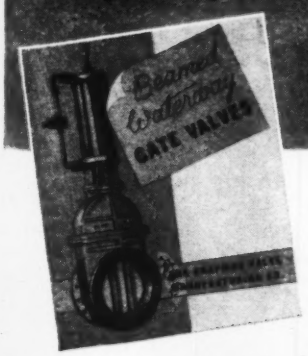
CHAPMAN

Beamed Waterway Gate Valves

1. Special bronze-faced beams in the downstream port of the valve body which provide extra bearing contact.
2. No tipping of the disc into the waterway since the beams are located in a vertical position.
3. No uneven wear of seat rings and consequent leakage because the downstream disc is held securely in its relative position when throttling the flow through the valve.



Chapman Beamed Waterway Gate Valves have been tested and proven over many years under severe working conditions in large water filtration plants. These important features make these valves unusually efficient under throttling conditions and assure longer valve life.



Bulletin giving reports from water filtration plants is now available for engineers.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS

GET YOUR AIR COSTS DOWN TO JAEGER FIGURES

1. More air, and cooler, drier air per pound of fuel — a direct, day-to-day cost saving.

2. Full power behind your tools — no waiting — more work done per dollar of wages.

3. Lowest upkeep cost of any compressor you have ever owned.

Efficient mass production in our new compressor plant makes possible machines of this quality at bedrock prices. See your Jaeger distributor or write us for Catalog.

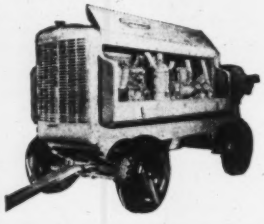
75% to 100% larger "ultra lapped" valves,

20% to 30% slower piston speed,

100% efficient intercooling; force feed lubrication.

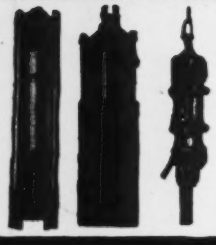
50% larger air receivers,

60 to 600 ft. sizes.



THE JAEGER MACHINE CO.
Main Office and Factory, Columbus 16, Ohio
REGIONAL OFFICES:
New York 17, N. Y. 8 E. 48th St. | Chicago 1, Ill. 226 N. La Salle St. | Birmingham 1, Ala. 235-8 American Life Bldg.

McKiernan-Terry



PILE HAMMERS and EXTRACTORS

Now made in sizes of complete, standardized line of ten double-acting hammers, five single-acting hammers and two double-acting extractors. Write us for free descriptive Bulletins 55 and 57.

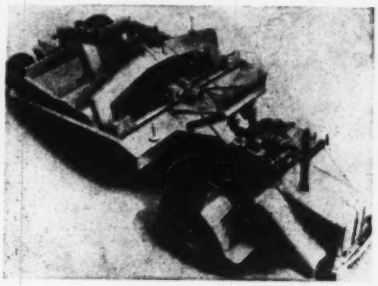
MK-257

McKIERNAN-TERRY CORPORATION MANUFACTURING ENGINEERS
13 PARK ROW, NEW YORK 7, N. Y.

three-braid heavy-duty for air drill usage. Hose sizes range from ⅜ to 1½ in. in 25-50-ft. lengths or 450-ft. reels.—*Goodyear Tire & Rubber Co., Akron, Ohio.*

175

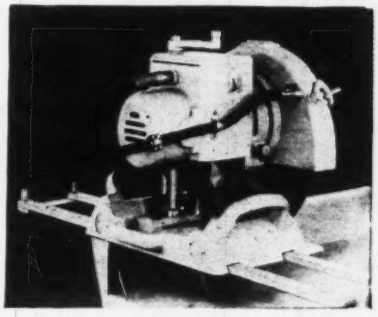
SELF-PROPELLED EARTHMOVER—Increased power in this new "Terra-Cobra" earthmover enables it to climb steeper grades and traverse soft mud, sticky clay and loose sand under heavily



loaded conditions with plenty of pull and minimum gear-shifting. It has a larger clutch and heavier duty transmission. It has positive 2-wheel hydraulic steering control. It has four forward speeds up to 17 mph. fully loaded and one speed reverse. The scraper bowl has a heaped capacity of 17.5 cu. yd. and 14.0 yd. struck.—*Wooldridge Mfg. Co., Sunnyvale, Calif.*

176

STONE SAW—Portable electric guided saw cuts wet or dry using diamond or abrasive wheels. Cuts granite up to 5 in. in depth at 4 sec. per sq. in. and



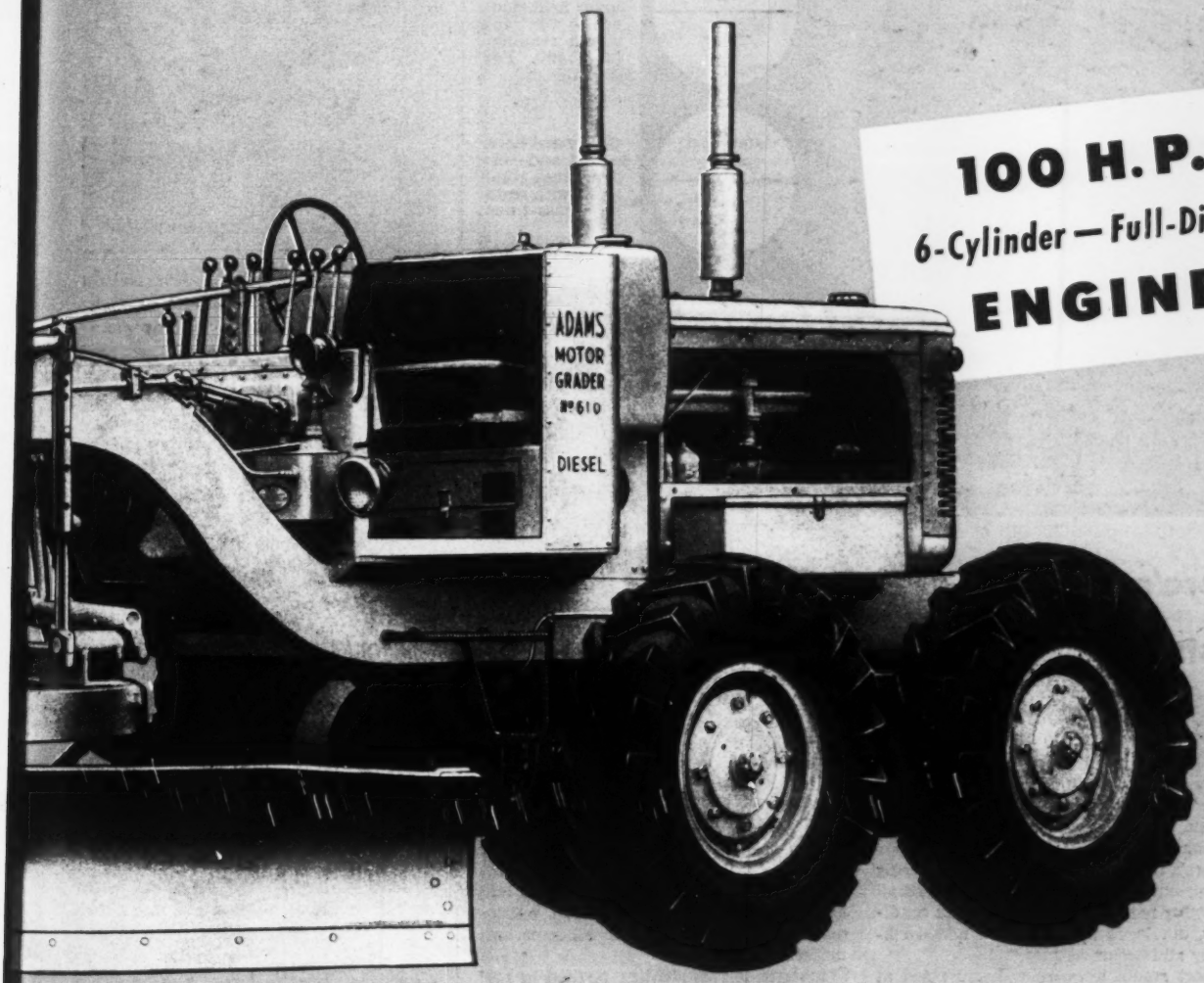
up to 10-ft. lengths with 14-in. wheel. Designed with 5-point suspension at strain points where balance and proper weight distribution are most essential. Weighs 78 lb. Available with standard rails 4 and 6 ft. long or with clamping rails from 6 to 10 ft. long. Unit is powered by 2½-hp. motor operating at 2200 to 2800 rpm.—*Stone Machinery Co., Manlius, N. Y.*

177

EXTERIOR PAINT—A new type of exterior paint which the manufacturer says is non-inflammable, fire-resistant, capable of being applied over moist surfaces and repellent to marine insect life is being placed on the market. Unusual characteristics of the paint are attributed to a fish oil base and the

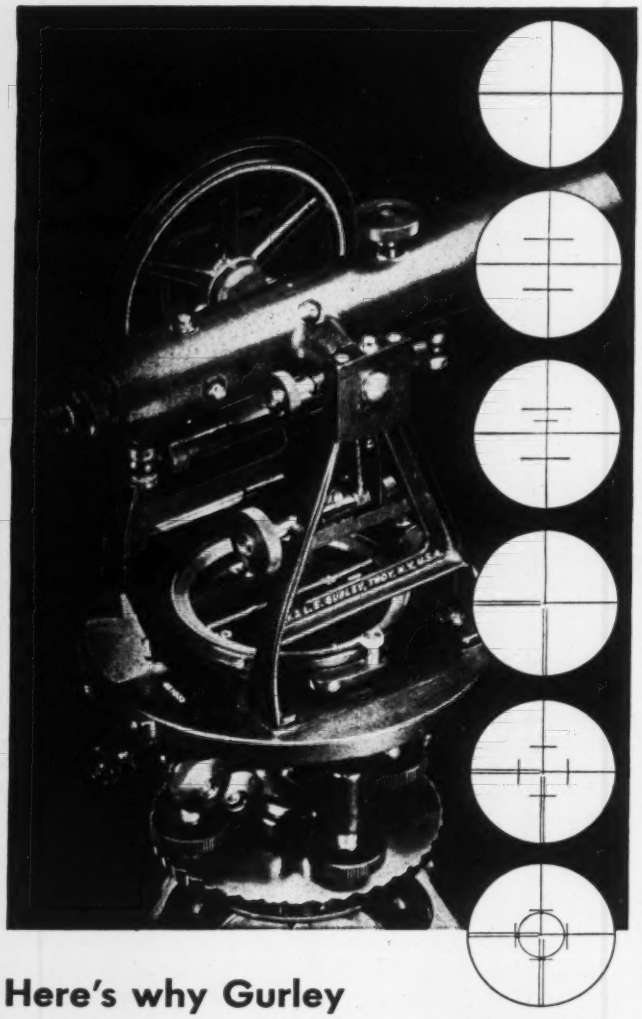
Look at These Outstanding Advantages

- 100 H.P. Full-Diesel Engine—6-cylinder—powerful, dependable, economical.
- Weight to utilize *all* of the horsepower—in *all* gears.
- Push-Button Starting from the cab—standard equipment.
- Power Steering—standard equipment. Of mechanical-hydraulic type — provides all the "feel" and advantages of mechanical steering, with power doing the work.
- Big, Fast-Acting 4-Wheel Hydraulic Brakes on tandem for safe, easy stops.
- Large, Wide-Tread Tires (14.00-24 rear, 11.00-24 front). Adequate traction and flotation is assured for every type of motor grader operation.
- 8 Overlapping Forward Speeds, 2 reverse speeds. High transport speed of 25 mph.
- Exceptionally Wide Blade (31 in.) to utilize the No. 610's great capacity.



100 H.P.
6-Cylinder — Full-Diesel
ENGINE

ADAMS manufactures the most complete line of motor graders in the world —five models, ranging from 31 H.P. to 100 H.P. There's an Adams Motor Grader with the right power and capacity to fit your needs—exactly. For complete information, see your local Adams dealer.



Only Gurley Offers These Improved Reticles

A. Plain cross-lines. For Levels.

B. Cross-lines and stadia lines, spaced 1:100.

E. & F. Quarter-interval stadia lines in upper or lower field, added to "B" for stadia readings of 1:400. For Alidades.

O. Parallel horizontal and vertical lines combined with regular cross-lines.

T. Stadia lines spaced 1:100 horizontally and vertically, added to "O".

S. Solar reticle. A combination of "O" and "T" with a circle 15′ 45″ radius for centering the sun's image.

Here's why Gurley Instruments now feature quick-reading glass reticles...exclusively

Study these new reticle patterns. Think of them in the telescope of your new Gurley transit. They'll make your next surveying assignment much easier.

Here's the latest advance in engineering instrument design—*glass reticles* to suit all surveying requirements and climatic conditions, developed by Gurley for added efficiency and accuracy.

Short stadia lines, spaced and ruled at precise intervals, are quickly identified since they do not extend over the entire field of view, as in continuous filament reticles. There is no chance of confusion with the regular cross-lines, nor can they be affected by moisture.

Several reticle pattern designs are available in Gurley instruments, from parallel horizontal and vertical lines, combined with cross-lines for triangulation and stellar observations, to solar reticles for centering the sun's image. Besides those illustrated Gurley can provide other patterns and vary the weight of reticle lines to suit your requirements. Gurley's knowledge of optics, lens grinding and specially developed reticle-making equipment assure all-important uniformity of line.

Investigate this sighting method in new Gurley instruments, exclusive with Gurley. Write today for our bulletin No. 50 with its detailed description of the complete line of Gurley products. W. & L. E. GURLEY, UNION PLAZA, TROY, NEW YORK.

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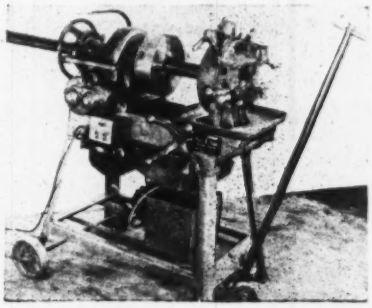
Scientific and Surveying Instrument Makers since 1845

Engineering and Surveying Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Aeronautical Navigating Instruments, Meteorological Instruments, Reticle Making Facilities.

special solvent used, which also is said to give a penetrating ability that makes the paint especially suitable for seal-coating concrete block and other surfaces of high porosity. It is also claimed that it will repel termites and prevent dry-rot.—*Nu-Oil Paint Co., 2322 Newton St., San Diego, Calif.*

178

PIPE THREADER—New model Red-E-Haul portable power pipe threading machine is designed for installation and maintenance of all piping from $\frac{1}{4}$ to 2 in. Use of simple auxiliary equipment can extend this range to all sizes



from $\frac{1}{8}$ to 12 in. Flip of lever selects size instantly with Double Quick die head, so any pipe can be cut chamfered, reamed or threaded without changing dies. Switch for 1-hp. motor incorporates double electric outlet for lights and small power tools. Built-in safety features include check, wrench ejector, electrical overload protection and automatic power pump coolant system.—*American Die & Tool Co., 2nd & Buttonwood Sts., Reading, Pa.*

179

BRANDING IRONS—Individual characters on new line of electric branding irons, suitable for branding dates on

tires, timber and batteries, are readily interchangeable while hot by simple adjustment of set screw. There are stock sizes for eight or less characters, $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ in. high. They operate off 110 or 220 v. circuit, a.c. or d.c., any cycle, and are equipped with 6-ft. cord and plug.—*Hexacon Electric Co., 239 W. Clay Ave., Roselle Park, N. J.*

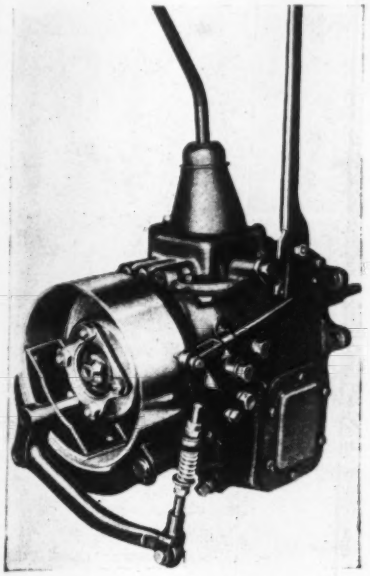
180

NON-TILTING MIXER — This new 3½-S non-tilting concrete mixer has some unusual features. The drum and drumheads are made of heavy steel plate and revolve on wide solid rubber rollers with guides to hold true running location and to prevent weaving of the drum. There is an automatic water tank for predetermined quantities of water for each batch. The drum is gear-driven and a heavy roller chain trans-

mits the power from engine to counter' shaft. Complete units weighs about 1,000 lb.—*Muller Machine Co. Inc., Metuchen, N. J.*

181

BRAKE—Due-Grip emergency brake, available in complete range of capacities from 6 to 14-in. dia., consists of two shoes, located on inner and outer surfaces of brake drum, which are actuated through lever. In operation,



inner and outer shoes are drawn toward each other simultaneously, applying pressure to drum on both its interior and exterior surfaces. When lever is released, both shoes release their hold on drum and permit it to rotate freely between them without drag. Rapid dissipation of heat is insured. since more than two-thirds of both inner and outer brake drum surfaces are exposed to air.—*Timken-Detroit Axle Co., Detroit 32, Mich.*

182

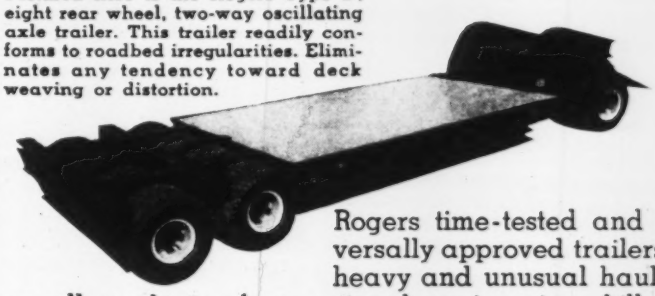
TWIN JAW CRUSHER—Two movable jaws operated by two eccentric shafts and double set of flywheels are features of new line of jaw crushers. They are specially suited for installation in portable plants because of reduction in drives and savings in space by combining lengths, heights and widths of two crushers into one. Four sizes are available: 12x16, 16x24, 12x36 and 18x36. —*Iowa Mfg. Co., Cedar Rapids, Iowa*

183

PORTABLE WELDER—P&H Model WN-200 is now available with extra power supply. Offered as optional equipment, unit provides 1½ kw. of alternating current at 115 v., single phase. This enables electric lights to be hooked up from floodlighting during welding, as well as permitting use of electric powered tools. Any universal ac.-dc. portable tool can be operated

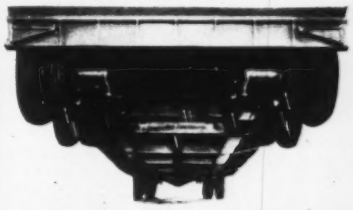
are built with MORE than QUALITY MATERIALS

Pictured here is the Rogers Type D, eight rear wheel, two-way oscillating axle trailer. This trailer readily conforms to roadbed irregularities. Eliminates any tendency toward deck weaving or distortion.



Rogers time-tested and universally approved trailers for heavy and unusual hauling, are all products of exceptional engineering skill, acquired over a period of more than 32 years.

Progressive evolution has produced a complete line of trailers UNCOMMONLY STRONG but COMPARATIVELY LIGHT. They may be loaded easier and moved through traffic with greater speed and safety. They render exceptionally long periods of service with remarkable freedom from repair expense. AN IMPRESSIVE RECORD OF REPEAT ORDERS stands as convincing evidence of Rogers long and continued acceptance.



Shown above and at right are two views of the Rogers Walking Beam Trailer. Side swinging brackets permit operation with 8 or 10 ft. deck widths to conform to certain state requirements.

ROGERS BROS. CORP.

DESIGNERS and BUILDERS OF HEAVY DUTY TRAILERS SINCE 1915

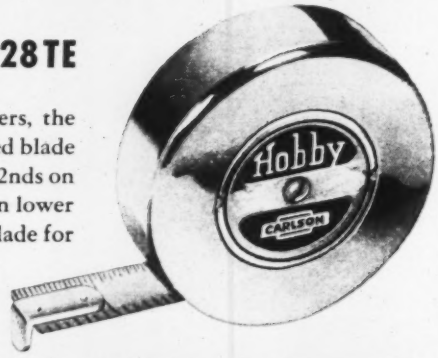
EXPERIENCE builds 'em PERFORMANCE sells 'em

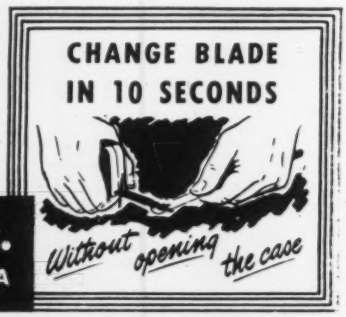
135 ORCHARD ST. ALBION, PENNA.

GET A CARLSON ENGINEER'S STEEL TAPE RULE

The **HOBBY** #128TE
(8 FOOT)

Especially designed for engineers, the Carlson Hobby 128TE, has etched blade with graduations in 16ths and 32nds on top edge and 10ths and 100ths on lower edge. Both are on same side of blade for easy conversion. The Hobby 128TE like all Carlson Rules has the famous economy feature – when blade becomes worn, you can replace it with a new one in just 10 seconds without opening the case. Replacement blades cost about ½ the price of a new rule. GET A CARLSON ENGINEER'S RULE FOR TOP QUALITY AND REAL ECONOMY.





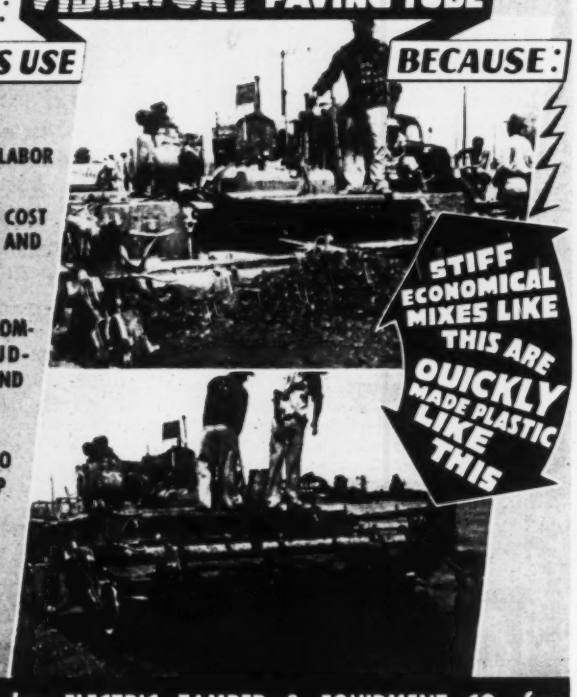
CARLSON & SULLIVAN, Inc.
MONROVIA, CALIFORNIA

HIGHWAY ENGINEERS SPECIFY: The JACKSON VIBRATORY PAVING TUBE

CONTRACTORS USE BECAUSE:

- SAVES CEMENT AND LABOR
- LOWERS SPREADING COST SPEEDS UP FINISHING AND IMPROVES QUALITY
- ASSURES PERFECT COMPACTION AND PUDDLING AT FORMS AND JOINTS
- EASILY ADAPTABLE TO SLABS 6" to 24" DEEP and 10' to 25' WIDE — *in the field.*

Write for the complete facts—NOW!



Manufactured by ELECTRIC TAMPER & EQUIPMENT CO. *for*
JACKSON VIBRATORS, INC. LUDINGTON, MICH.

from this unit. Welder is N.E.M.A. rated machine of 200 amp., with welding service range of 30 to 260 amp. — *Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14, Wis.*

184

PORTABLE TROUGH CONVEYOR — Specially designed for loading, unloading or stockpiling all loose materials,

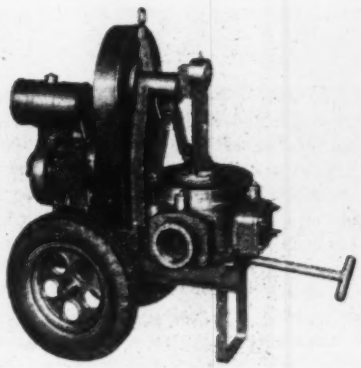
and for moving concrete from mixer to forms, conveyor is built in standard belt widths of 16, 20 and 24 in. and standard lengths from 20 to 60 ft. Fitted with electric motor or gasoline engine, it has capacity from 60 to 180 tons per hour.—*George Haiss Mfg. Co., 381 Canal Place, New York 51, N. Y.*

185

PIPE JOINT COMPOUND — In jumbo stick form, this compound permits using only the exact amount needed to insure perfect sealing. It is said to be a quick, clean, permanent and economical pipe joint sealer.—*Lake Chemical Co., 607 N. Western Ave., Chicago 12, Ill.*

186

DIAPHRAGM PUMP — Strength and durability feature this new diaphragm pump for sludge, mud, seepage,



grit, sewage, slime and other fluids with a solid content up to 25 percent. Roller bearings are used on pump rod and in main transmission.—*The Carver Pump Co., Muscatine, Iowa.*

187

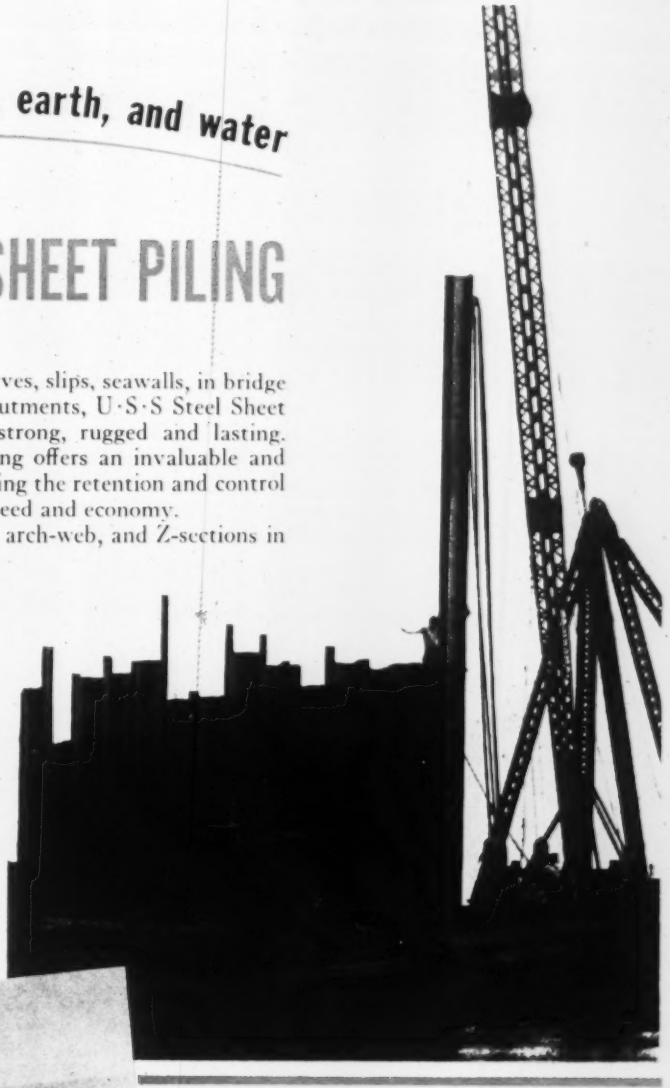
ARC WELDING MACHINE — New Hornet 36A motor generator heavy-duty machine is available in 200, 300

for strong walls to retain sand, earth, and water

U·S·S STEEL SHEET PILING

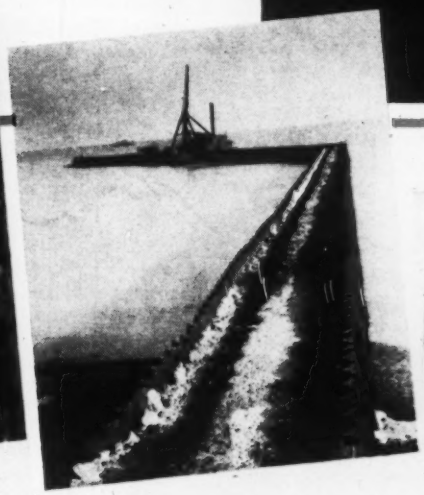
In cut-off and core walls for dams and dikes, in wharves, slips, seawalls, in bridge pier retaining walls and in railroad and highway abutments, U·S·S Steel Sheet Piling offers easily installed construction that is strong, rugged and lasting. Forming a continuous wall, U·S·S Steel Sheet Piling offers an invaluable and versatile construction medium for any project involving the retention and control of earth or water, it offers the double advantage of speed and economy.

U·S·S Steel Sheet Piling is made of straight-web, arch-web, and Z-sections in a complete range of sizes and sections.

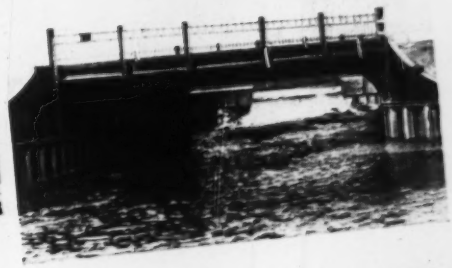


CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh and Chicago
COLUMBIA STEEL COMPANY
San Francisco, Pacific Coast Distributors
TENNESSEE COAL, IRON & RAILROAD COMPANY
Birmingham, Southern Distributors
United States Steel Export Company, New York
8-154

When the wooden piles under this valuable dock started to deteriorate as the water level fell, the owners simply surrounded their dock on the water sides with U·S·S Steel Sheet Piling.

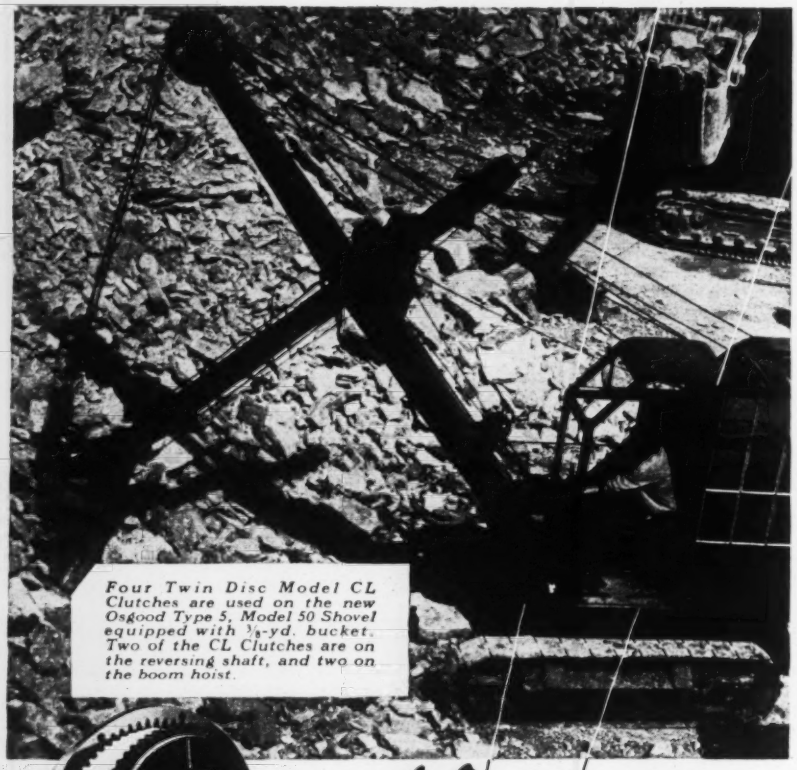


600 tons of interlocking U·S·S Steel Sheet Piling assure practical sand-and-water tightness throughout the entire length of this 800 foot pier and breakwater to afford permanent and economical shore protection.

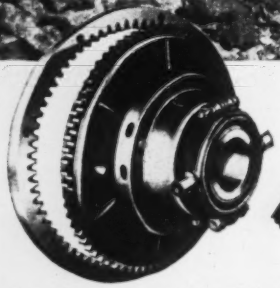


The two long abutments of U·S·S Steel Sheet Piling under the superstructure of this all-steel, single span bridge, support a load of 9 tons per lineal foot of wall.

UNITED STATES STEEL



Four Twin Disc Model CL Clutches are used on the new Osgood Type 5, Model 50 Shovel equipped with ¾-yd. bucket. Two of the CL Clutches are on the reversing shaft, and two on the boom hoist.



Twin Disc Model CL Clutch

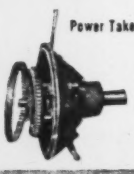
Maximum performance . . . minimum space

Some construction jobs call for small yet rugged equipment . . . equipment built to work fast and hard in cramped space.

Answering this need, construction equipment manufacturers have produced tough, little shovels, designed and engineered to meet the job requirements. Into these machines, manufacturers have put Twin Disc Model CL Clutches, because this friction clutch is built to give maximum performance in minimum space.

For requirements limited by space, Twin Disc Model CL Clutches are built with one, two and three friction plates . . . sizes from 5.5″ to 11.5″ . . . and are designed to transmit loads of from 1.5 to 19.5 hp per 100 rpm. Maximum bore sizes are available to accommodate oversize shafts.

Providing single-point adjustment, plus extreme ease in engagement and disengagement, Model CL Clutches are supplied with gear tooth drive for easy assembly. Readily attachable driving rings are available for use with flywheels, drums and pulleys, For complete specifications, write for Bulletin No. 120-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).



Power Take-off

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

Machine Tool Clutch

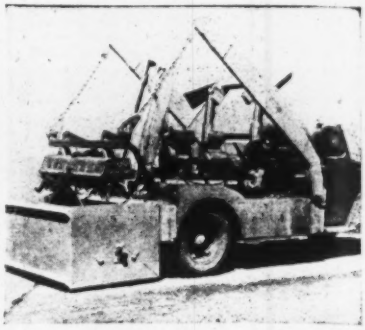
Marine Gear

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

and 400-amp. models, designed for either 220 or 440 v. with no change in relays or additional wires required for voltage reconnections.—*Wilson Welder & Metals Co., Inc., 60 E. 42nd St., New York 17, N. Y.*

188

ROAD SWEEPING MAGNET — Stearns 18x96-in. magnet is combined with Dempster-Dumpster body to pick up and carry scrap metal from road surfaces. Magnet is detachable by



removing two pins and chains. Height of magnet above ground is adjusted by raising or lowering boom of unit. Gasoline-engine-powered generator supplies electrical energy to magnet. Accompanying illustration shows magnet ready to dump scrap metal into body receptacle.—*Stearns Magnetic Mfg. Co., 635 South 28th St., Milwaukee 4, Wis.*

189

INSULATING PLASTER — A plastic mineral cork makes an insulating plaster for interior application in industrial buildings, homes, and public buildings. It is a light density, fire-resisting, granular material which when mixed with the directed quantity of water forms a smooth plastic mass. Troweled on any clean, rigid interior wall or ceiling surface in any desired thickness, it will set to form a durable insulating blanket which also has sound-absorbing properties.—*Building Materials, Inc., 208 W. Las Animas, Colorado Springs, Colo.*

190

REFLECTING ROADSTUD — An effective new highway safety device is a self-wiping reflecting roadstud known as "catseye." Each one has two reflecting lenses housed in a resilient bridge-shaped rubber pad which clips into a box-shaped metal base with protecting ramps. It is placed in the center of the highway where light from automobile headlamps is reflected, thus marking a definite lighted center line for traffic visible from 50 to 100 yd. in fog and 1,000 ft. on clear nights.—*Highway Safety Co. Inc., Frederick, Md.*

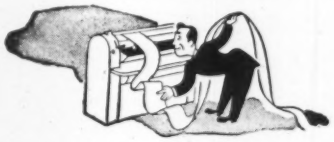
191

BULLDOZER — Angling type, hydraulically controlled, for exclusive use

NEW! THE OZALID STREAMLINER

- Reproduces your engineering and architectural drawings in seconds—also your typed, printed, photographic material.
- Moderately priced . . . designed for the thousands of drafting rooms that want these 5 EXTRA VALUES in Printmaking at no extra cost—

1. EFFICIENCY! You always get positive (not negative) prints direct from your tracings . . . prints that are sharper, brighter, much easier for you to read, check, and make notations on.



You produce these without waste of material or waste of motion. Your tracings can be up to 42 inches wide, any length . . . and can be printed either on rolls of Ozalid sensitized paper or on cut sheets of matching size.

Your prints are always delivered dry, ready for immediate use . . . after just two simple operations—Exposure and Dry Development.

2. SPEED! ONLY 25 seconds to reproduce your standard-size tracings, specification and data sheets, etc.

3. ECONOMY! An 8½ x 11-inch reproduction costs you *one cent;* 11 x 17 inches, two cents . . . and so on. The Ozalid Streamliner soon pays for itself . . . in time, labor, and dollars saved.

With it, you can also effect amazing short cuts in design. For example—eliminate redrafting when changing obsolete drawings . . . combine the details of separate tracings on *one* print . . . re-

claim old or worn tracings . . . make transparent overlays in different colors.

4. VERSATILITY! You can reproduce the lines and images of any original in black, blue, red, sepia, or yellow . . . on paper, cloth, foil, film, or plastic.

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tinuous-tone prints from film positives (which can be made from any negative) . . . OZAPLASTIC to produce oilproof, waterproof prints for shop or field use. *All* prints are made in same fast, economical manner.

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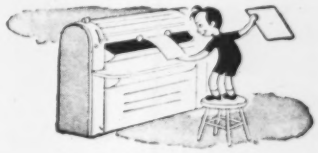

Anyone can feed originals and sensitized material into the Ozalid Streamliner. Prints are delivered on top, stacked in order—within easy reach of the operator, who does not have to leave her chair.

You can install your Streamliner anywhere; it requires only 11 square feet of floor space.

Write today for free, illustrated booklet . . . showing all the ways you can use the new OZALID STREAMLINER . . . and containing actual reproductions—like those you can make.

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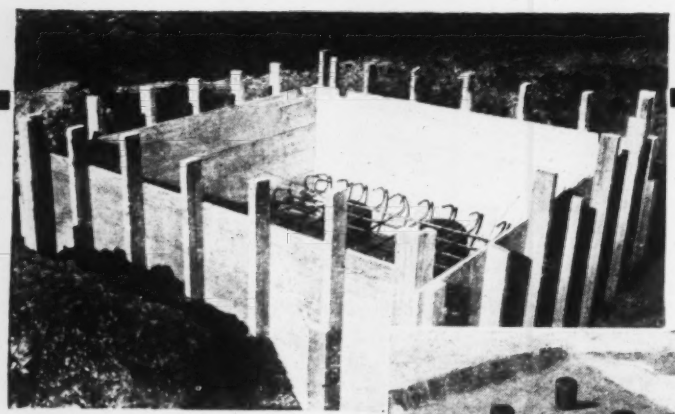
PILES



Koppers Pressure-Creosoted Piles in an Ammonia Storage Tank foundation

Wherever a foundation job calls for piling—*it's good business to call for Koppers Pressure-Creosoted Piles!*

Pressure-creosoted piles—tops soaked in creosote and capped in concrete—are included in modern building codes for permanent foundations. Penetration of creosote protects the wood against decay and termites. The surrounding earth smothers evaporation of the creosote.

Creosoted piles, pulled after nearly 50 years use, were "reeking with creosote."

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with diesel D4 track type tractor. Provides either straight or angling type blades. Hydraulic piston has positive action, balanced vane pump and manually operated control valve with "raise," "lower," and "hold" positions. Available in 88 in. and 108 in. blades. Blade has 31 in. lift above ground. Maximum blade pitch adjustment is 25 deg. and maximum tilting adjustment is 6 in.—*Caterpillar Tractor Co., Peoria 8, Ill.*

192

STEEL PLATES—Torch-cut to desired size and shape and welded on with Amsco nickel-manganese steel rods or electrodes, these impact and abrasion resisting plates provide restoration of worn manganese steel or ferrous areas and pre-installation protection of ordinary ferrous parts at points subject to wear. Austenic nickel-manganese steel plates are available ¼, ⅜, ½, ⅝, ¾ or 1 in. thick either in standard 4x12-ft. size or cut to order.—*American Manganese Steel Division, American Brake Shoe Co., Chicago Heights, Ill.*

193

FIRE RETARDANT PAINT—Resistall, new high gloss enamel paint, can be used for both prime and finish coats and can be reduced with any of common thinners and tinted with regular oil colors without impairing its fire retardant qualities. Surfaces will not flash, flame or burn and are coated with tough film of protection that resists attacks of fire, weather, moisture, salt air and water. Paint can be used on wood, plaster, cement, metal, insulation board and acoustical tile.—*Brytenu Chemical Mfg. Co., 408 Madison Ave., New York 2, N. Y.*

194

HEAVY-DUTY JACKS—Load pump and speed pump are combined into one unit on new 30 and 50-ton hydraulic jacks. Load pump cuts in automatically when speed pump has raised saddle to load. Bases are machined from steel blocks 2¾ in. thick to withstand extreme stress. Other features include recessed safety release valve, overall closed construction, ports for gage or valve installation, pump beam protection, carrying handle, and on-the-side operation. Both models are one-man operated.—*Blackhawk Mfg. Co., Milwaukee 1, Wis.*

195

HOIST—Coffing Hoist Co. recently introduced a new "Mighty Midget" puller designed to pull or lift 500 lb. easily in spite of its portable, handy size. Weighing 6½ lb., and easy to use, the new puller has scores of maintenance and construction uses.—*Coffee Hoist Co., Danville, Ill.*

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The three illustrations to the right are typical combinations of VIBER's interchangeable units.

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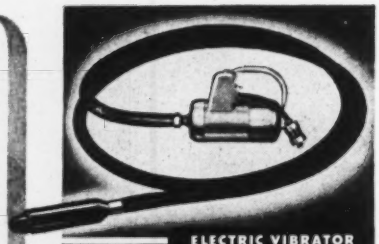
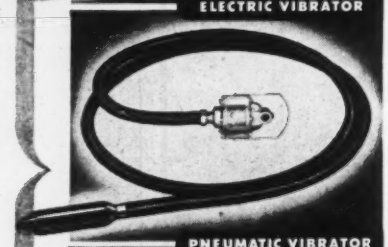

ELECTRIC VIBRATOR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Manufacturers' Publications

196

Standard Buildings—A 12-page illustrated booklet describes prefabricated buildings designed to be erected from standard production-built units specifically engineered to make them adaptable for many industrial and commercial uses. Structures are fabricated from heavy rolled steel sections and are available in two design loads, both calculated to meet rigid building codes. Although the basic building is featured with corrugated steel sheets which provide the most economical covering, the structural steel frames are designed for use with protected metal and corrugated asbestos cement sheets or with masonry walls and built-up roof. A wide variety of combinations is possible as there is considerable flexibility in the system.—*Luria Engineering Corp., 500 Fifth Ave., New York 18, N. Y.*

197

Scrapers — (Two pamphlets) Describe and illustrate with action photos hydraulic and cable-operated scrapers.—*LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa.*

198

Synthetic Resins—(20-p. booklet) Includes description of properties and uses of all company's synthetic resins. Chart provides key to specific uses.—*Hercules Powder Co., Wilmington, Del.*

199

Belt Conveyors — (New bulletin) Gives vital information for laying out belt conveyor system and points out features of Robins Idlers.—*Hewitt-Robins, Inc., Passaic, N. J.*

200

Arc Welders—(36-p. catalog) Contains illustrations, descriptions, dimensions and specifications on complete line of Simplified arc welders, electrodes and accessories.—*Hobart Brothers Co., Troy, Ohio.*

201

Oil Filters—(16-p. catalog) Contains scaled diagrams of many types of oil filters for diesel engine applications, with detailed specification charts giving all necessary technical information on construction, dimensions, capacity, weight, etc.—*Purolator Products, Inc., Newark 2, N. J.*

202

Concrete and Masonry Construction—(4-p. pamphlet) Describes methods and products used to solve problems in concrete and masonry construction. Spe-

cifications are given for concrete, mortar, surface protection and joints. Highlights are presented on maintenance and repair problems, such as sealing leaks against pressure and repairing structures.—*Sika Chemical Corp., 35 Gregory Ave., Passaic, N. J.*

203

Waterproofing—(4-p. circular) Describes uses of No. V transparent waterproofing for outside walls of brick, stone, stucco and kindred structures.—*Ranetite Mfg. Co., 1917 S. Broadway, St. Louis 4, Mo.*

204

Battery Charger and Arc Welder—(Single sheet) Describes new portable combination battery charger and arc welder.—*Larkin Lectro Products Corp., 160 W. 146th St., New York 30, N. Y.*

204A

Bulldozer—(Illustrated folder) Describes new rubber-tired Tournadozer for dozing, pushing, with specifications.—*R. G. LeTourneau, Inc., Peoria, Ill.*

205

Integral Seat Valves—A new catalog section describes forged steel chrome-molybdenum valves for service at 1,500 and 2,500 lb. at 1,000 F. It contains details of construction, dimensional and design data, and material specifications.—*Edward Valves, Inc., subsidiary of Rockwell Mfg. Co., East Chicago, Ind.*

206

Welding Rods Catalog — (24-p. brochure) Devoted to gas welding wire and its use. Good index. Numerous application photos.—*Page Steel & Wire Division, American Chain & Cable Co. Inc., Bridgeport 2, Conn.*

207

Material Handling Equipment—92-p. catalog) Describes complete line of vibratory material handling equipment, which includes electromagnetic vibrators, packers, feeders, vibrating grizzlies, lawns, paper juggers, hoppel level switches, vibrators, jolters, feeder machines and machanical shaft seals. Construction and maintenance tools are also covered.—*Syntron Co., Homer City, Pa.*

208

Jacks—(4-p bulletin) Gives detailed descriptions of Simplex lever, screw and industrial jacks. Specification charts on Simplex-Jenny center-hole hydraulic pullers, Util-a-Tool, drop forged steel trench braces and timber braces.—*Templeton, Kenly & Co., 1020 S. Central Ave., Chicago 44, Ill.*

209

Lubricating Greases—(12-p. magazine) Covers flow properties of lubricating greases, with relationship of apparent viscosity. It describes labora-

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#7 of a series of informative articles on insurance and bonding.

What would it cost to replace your essential business records?

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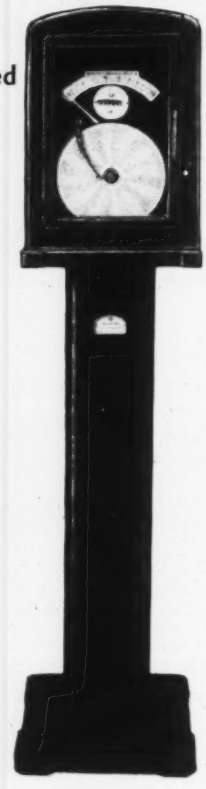

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tory work which has attempted to relate apparent viscosity to low temperature torque, low temperature consistency and dispensing characteristics of lubricating greases.—*The Texas Co., 135 E. 42nd St., New York 17, N. Y.*

210

Writing Materials — (48-p. catalog) Covers Microtomic Van Dyke pencil, draftsman's lead holder and leads, waterproof Van Dyke colored pencils, and other writing materials.—*Eberhard Faber Pencil Co., 37 Greenpoint Ave., Brooklyn 22, N. Y.*

211

Motor—(16-p. bulletin) Describes design and characteristics of new axial air gap motor for machine application.—*Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.*

212

Joint Installing Machines — (4-p. bulletin) Describes operations of Flex-Plane joint installing machines, which are now equipped for vibratory joint cutting. Various types of longitudinal dummy joint applications are illustrated.—*Flexible Road Joint Machine Co., Warren, Ohio.*

213

Supernatant Liquor Selection—Bulletin 343, released by the Pacific Flush-Tank Co., points out the inefficiencies of conventional methods of supernatant liquor selection and withdrawal and shows how the company's Supernatant Selector and Supernatant Gauge, Sight-Glass and Sampler provide a simple, practical and efficient solution.—*Pacific Flush-Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.*

214

Protective Clothing—A 12 page catalog section on the industrial protective clothing it merchandises has been published by the B. F. Goodrich Co. The publication pictures and describes both rubber and Koroseal (synthetic flexible material) garments. Included are the Koroseal industrial raincoat, acid proof apron, sleeve protectors, work suit, film industrial apron and heavy duty industrial apron. Rubberized products include economy work coat, general purpose work coat, storm suit and others.—*The B. F. Goodrich Co., Akron, Ohio.*

215

Pipe Line Equipment—New four-page folder, punched for loose leaf binding, presents in easy reference form information and data on internal alignment clamps for pipe line welding (both hand operated and electric) expanders and portable power units.—*M. J. Crose Mfg. Co., Inc., Tulsa, Okla.*

216

Truck Costs—Designed to provide a printed means by which truck operators can reduce operating costs by proper

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THE D-76 WITH FULL 76 H. P. DIESEL ENGINE *plus* ALL THESE ADDED FEATURES

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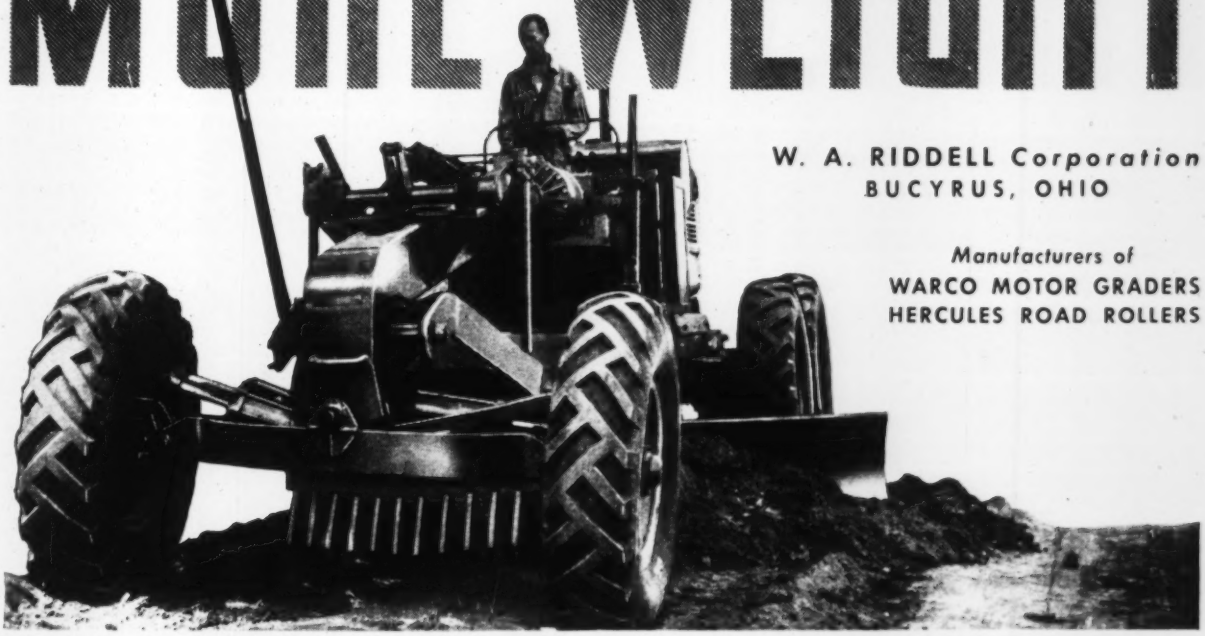

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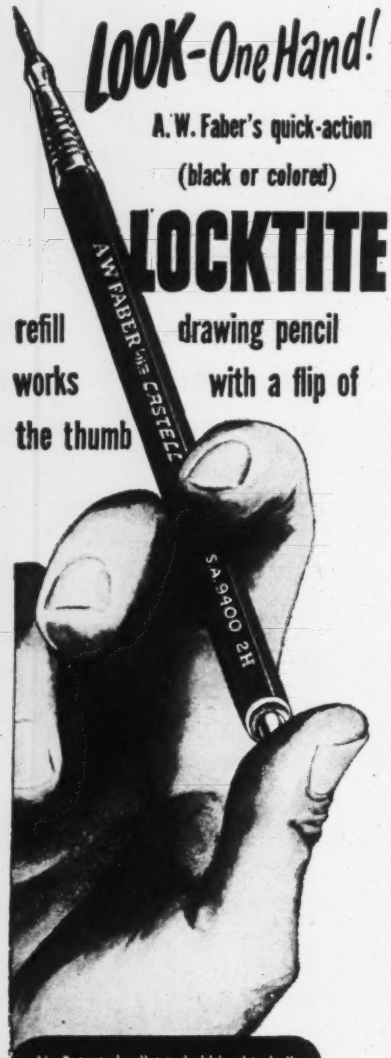

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selection and maintenance of tires, a new Truck Operators' Handbook has been published by The B. F. Goodrich Co. Featured is a discussion of the factors that can be controlled to get most service out of any truck tire, and information is given on control of proper air pressures; overloading and improper load distribution, and a formula for analyzing loads.—*The B. F. Goodrich Co., Akron, Ohio.*

217

Pump Bulletin—A new bulletin, No. 47-8020, describes the Hydroplex pump, a split case multi-stage centrifugal pump for low capacity and high pressure pumping. The 8 page, two colored booklet covers various views of the pump, cross section schematic, subassemblies, parts and dimensional-orthographic drawings, and installation photographs.—*Byron Jackson Co., Pump Division, Los Angeles 54, Calif.*

218

Bearings—The Federal Bearings Co. is now making available its 260-page ball bearing catalog "K" containing 100 pages of engineering information and data. It describes and illustrates all of the many types of anti-friction bearings produced by the company and contains interchange and conversion tables.—*The Federal Bearing Co., Inc.. Poughkeepsie, N. Y.*

219

Portable Pipe Tools—A 4-page folder illustrates and describes portable tools to groove pipe for victaulic pipe coupler. These groovers are ratchet-operated and easy to handle. They are said to be usable with a fraction of the effort required for ordinary pipe-threading stocks and dies, and are much faster in operation. The groovers are made in five sizes for ¾ in., 1 in., 1¼ in.. 1½ in. and 2 in. pipe.—*Victaulic Company of America, 30 Rockefeller Plaza, New York 20, N. Y.*

220

Arc Welders—A new 36 page catalog containing illustrations, descriptions, dimensions and specifications on the complete line of "Simplified" arc welders is now available. Included are electric motor driven DC welders in five sizes from 150 to 600 amp.; gasoline engine driven welders in four sizes; AC transformer type welders in three sizes; welding generators only in four sizes; gasoline engine driven welders with auxiliary AC or DC power generators, and other models.—*Hobart Brothers Co., Troy, Ohio.*

221

Wire Rope Manufacture—A booklet shows the various processes of making wire rope from wire rods through wire and rope mills. The story is presented in pictures with short captions.—*Macwhyte Co., Kenosha, Wis.*

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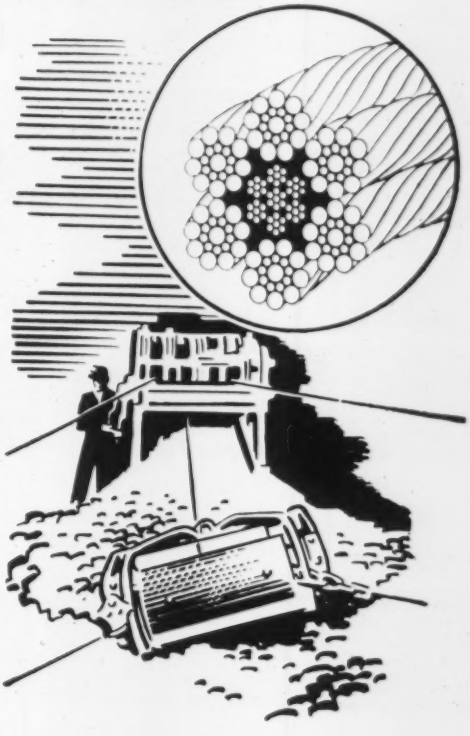
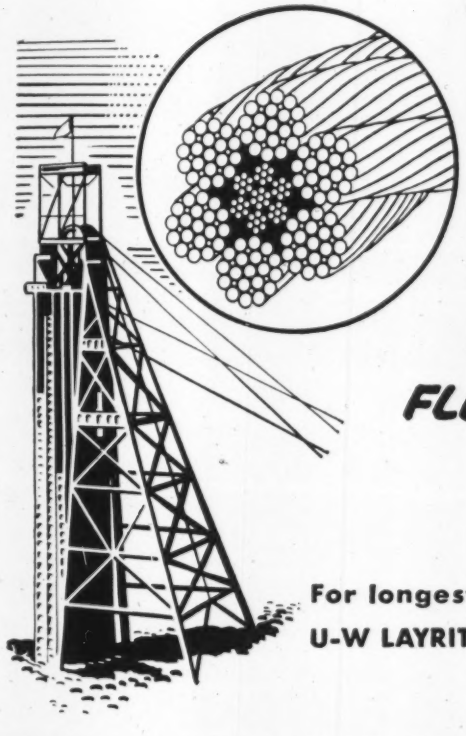


BUT...



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Men and Jobs

George A. Nelson, Boone, Iowa, city engineer and superintendent of water works, has resigned.

Stanley Markey has been named to the new post of Warren County sanitary engineer at Lebanon, Ohio.

D. Ford McCormick, of Eagle Point, Ore., has been appointed to the Oregon State Board of Engineering Examiners. A graduate civil engineer of the University of Texas, he also holds a degree in mining engineering from the Colorado School of Mines.

J. McCree Smith, graduate of North Carolina State College, has opened an office for the general practice of civil engineering at 1916½ Hillsboro Street, Raleigh, N. C.

Philip Clark, former Indiana State Highway Department draftsman, has been appointed assistant engineer of Tipton, Ind., to supervise completion of the city's $600,000 power plant and will do engineering work on sewer and street improvements.

Ned Williams has been designated chief of operations, electro magnetic plant, and deputy chief of the Clinton Production Division of the Atomic Energy Commission. A graduate of Clemson College, he held various positions in civil engineering and construction work in New York, Illinois, Kentucky and Nebraska and for 13 years was assistant bridge engineer of the Wyoming State Highway Department.

M. A. Ross, Columbus, has been named chief of the bureau of maintenance of the Ohio Highway Department, which he first joined in 1925 as a road surveyor. In 1933 he became a federal project engineer in Morgan County. He returned to the highway department in 1939 as an engineer in the maintenance department and in 1947 was promoted to assistant chief of maintenance under Earl L. Reeb, recently appointed Ohio highway director.

George Renfro, associate drainage engineer with the U. S. Department of Soil Conservation, has set up headquarters at Greenville, N. C., to make a survey of Green's Mill Run Creek to determine the cause of a disastrous flash flood last September which caused extensive damage.

Louis C. Brandt, Indianapolis, Inc., building contractor and former presi-

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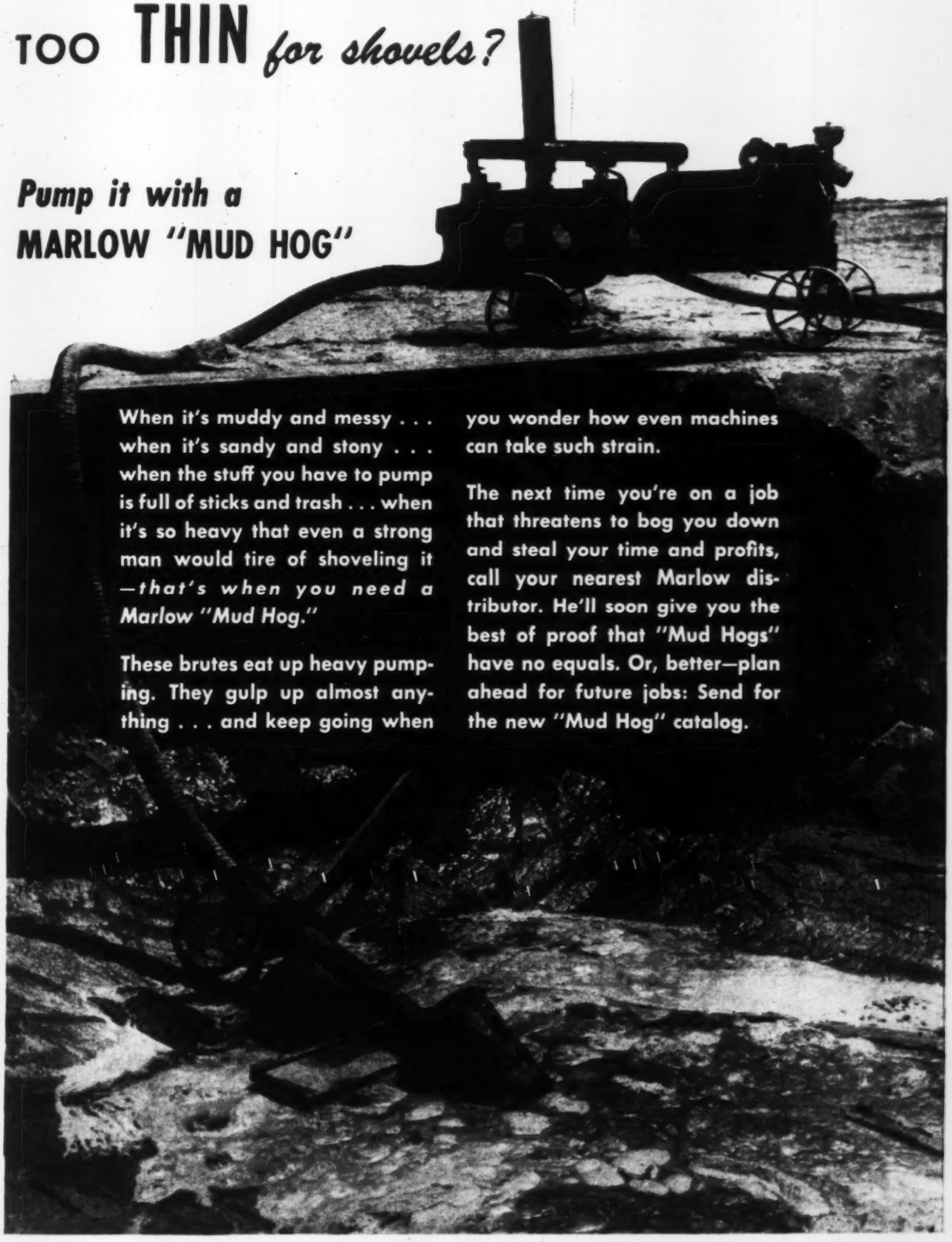

When it's muddy and messy . . . when it's sandy and stony . . . when the stuff you have to pump is full of sticks and trash . . . when it's so heavy that even a strong man would tire of shoveling it —*that's when you need a Marlow "Mud Hog."*

These brutes eat up heavy pumping. They gulp up almost anything . . . and keep going when you wonder how even machines can take such strain.

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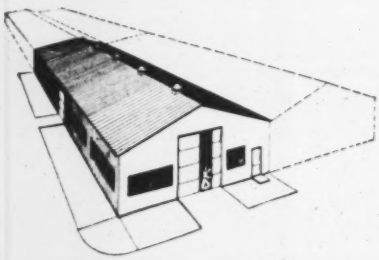

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dent of the Indianapolis Board of Works, has been named a member of the Board of Sanitary Commissioners to fill a vacancy caused by the resignation of **Fred N. Reynolds.**

Howard M. Ellis, civil engineer graduate of North Carolina State College, 1929, has been appointed head of agricultural engineering work for the college extension service. He has served for the last 11 years as an extension agricultural engineering specialist at the college. For four years he was with the engineering department of the Empire Oil and Refining Co. at Bartlesville, Okla. He returned to N. C. State College and in 1934 was awarded a B. S. degree in sanitary engineering while serving on the faculty of the civil engineering department. In 1934, he became assistant agricultural engineer with the Soil Conservation Service.

L. A. Lovell has joined the staff of International Engineering Co., Inc., at Denver, Colo., as design engineer. He has been connected with Parsons, Brinckerhoff, Hogan & Macdonald of New York since 1939 on work there and in several South American countries.

James M. Newman, Gainesville, Ga., public health engineer, has been named Stanly County sanitary engineer at Albemarle, N. C., succeeding **Arthur S. Lynn,** resigned.

G. E. Barber, an engineering graduate of North Carolina State College and recently maintenance superintendent of East Carolina Teachers College at Greenville, N. C., has been named maintenance engineer of the Greensboro, N. C., city schools. During the war he was a captain in the U. S. Engineering Corps.

Howard P. Maxton has been elected secretary and assistant treasurer of the Raymond Concrete Pile Co., New York. He has been assistant secretary and assistant treasurer, having joined the company in 1945. He is a graduate civil engineer of Washington University, St. Louis, Mo. As general cost engineer and chief estimator for the TVA, he organized the cost engineering department. From 1941 until 1945 he was head of the accounting and auditing division, U. S. Navy Department, Bureau of Yards and Docks. He developed the Navy manual, "Accounting, Auditing and Control of Cost-plus, Fixed-Fee Contracts."

Recent additions to the staff of Palmer and Baker, Inc., Mobile, Ala., include: **Frank L. Schwearingen,** chief of inspection of all of the company's construction work; **Col. Paul Brewer,** former chief of the highway planning

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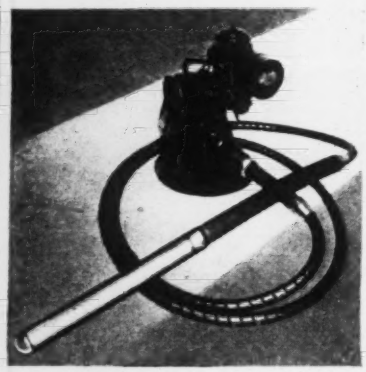

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survey for Indiana, in charge of traffic problems; and **John Bayliss,** in charge of material testing, soil laboratories and field explorations, **Robert R. Baker,** vice-president supervises all phases of engineering.

C. Fred Gurnham of 72 Lake St., Hamden 14, Conn., has entered the consulting engineer field to specialize in industrial waste treatment and disposal. He holds degrees from Yale and New York universities.

Theodore S. Bogardus, professor of engineering at Baldwin Wallace College, Berea, Ohio, has been appointed city engineer of Bay Village, Ohio. Professor Bogardus will continue his teaching activities, the new post requiring only part-time attention.

M. O. Giertsen has been appointed chief bridge engineer of the Minnesota State Department of Highways, succeeding E. J. Miller, who died Jan. 21. Mr. Giertsen is a graduate civil engineer, University of Minnesota, 1913. He has been with the Department of Highways since 1920, and has been assistant to the chief bridge engineer since 1931.

H. T. Livingston has been appointed chief engineer, maintenance of way and structures of the Chicago, Rock Island and Pacific R. R. Co. at Chicago, Ill.

Bruce K. Jones, of Raleigh, N. C., an engineering graduate of Clemson College, S. C., has been named hospital construction engineer of the North Carolina State Medical Care Commission, which is planning a large hospital construction program.

Herbert M. Eastwood, town engineer at Jacksonville, N. C., has been named mayor. He obtained his civil engineering degree from North Carolina State College in 1936 and went to Jacksonville in 1941 while working with William F. Freeman Engineering Co. of High Point, N. C.

J. Paul Buckley, for the last year engineer-director of the highway study made by a committee of the Michigan Good Roads Federation, has joined the staff of the Automotive Safety Foundation, which is making state-wide engineering investigations of road needs, similar to the Michigan study, in Oregon, Washington, Nebraska and Kansas. Mr. Buckley will serve as field supervisor and special consultant.

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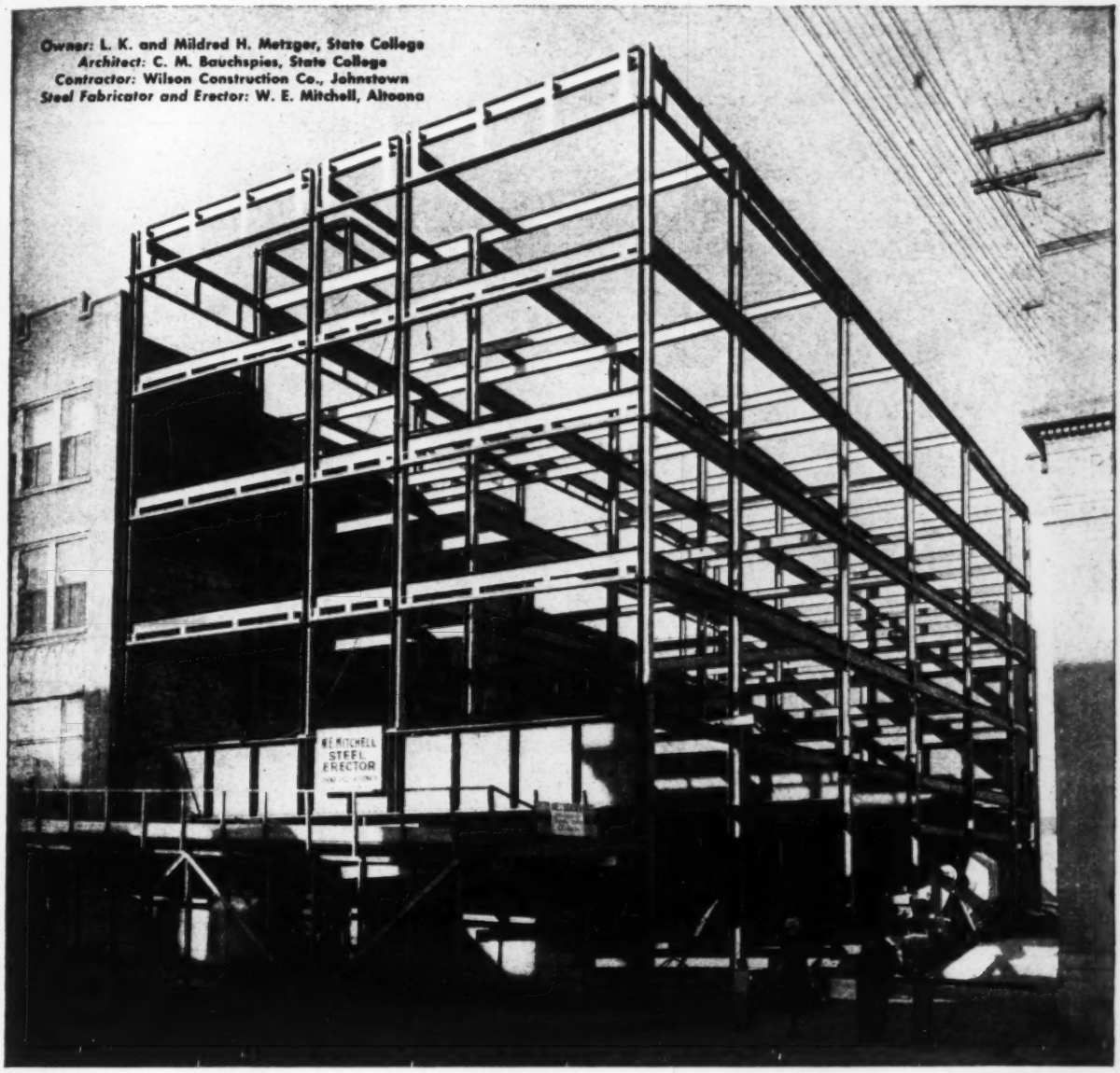

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New Store-Apartment Building at State College, Pa.

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The recently-completed structure, like scores of other buildings now under way in cities large and small, has a framework of Bethlehem Structural Shapes.

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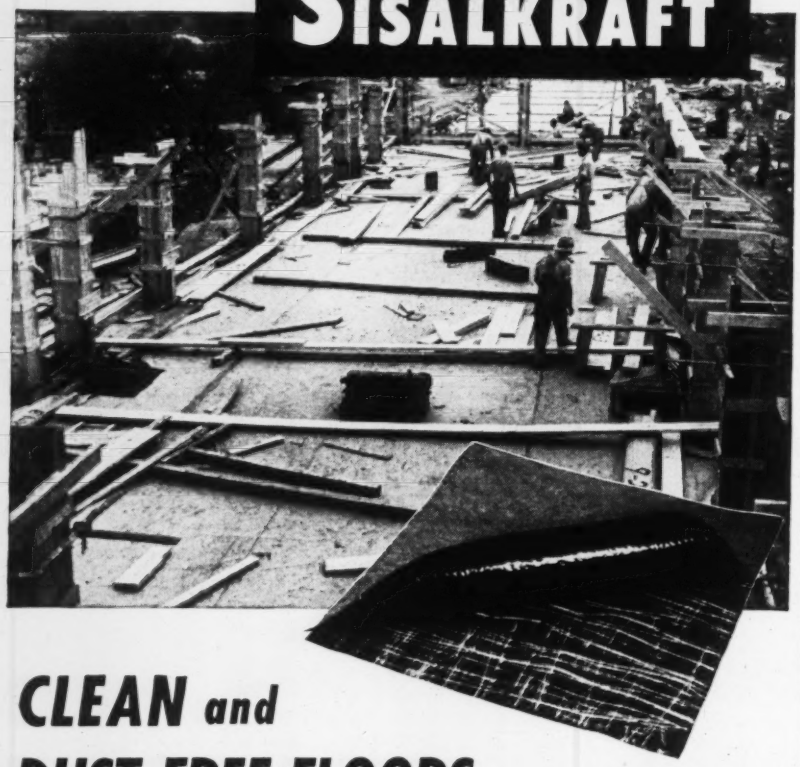

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The SISALKRAFT method is a "natural" for you on single-story and multi-story jobs, also for driveways, sidewalks and roads.

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Elections and Activities

Richard R. Ranson, supervising engineer of the Cutler-Hammer Co. has been elected president of the Milwaukee chapter of the Wisconsin Society of Professional Engineers. Other officers are: M. A. Blakey, vice-president; Robert H. Hopwood, secretary-treasurer; and Oscar A. Kisa, director. Herbert Moore, who headed the society last year, remains on the board with Ray A. Behrens and Arthur Simon.

The Ohio Contractors Association, has elected the following officers: President:—V. N. Holderman, V. N. Holderman & Sons, Columbus; vice-president:—W. E. Ringwald, Jr., W. H. Ringwald & Sons Co., Chillicothe; and secretary-treasurer: — Charles E. McKee, Columbus.

New officers of the Mid-South section of the ASCE are: Lee H. Johnson, of Oxford, Miss., dean of the school of engineering at the University of Mississippi, President; Gene Bespalow, Memphis, Tenn., vice-president; and H. G. Dewey, Clinton, Miss., secretary-treasurer.

The Association of Professional Engineers of Ontario, with a membership of 6,177 is the largest professional association in Canada. Newly elected officers are: G. L. MacPherson, Sarnia, president; J. W. Reid, Hamilton, and E. V. Buchanan, London, vice-presidents; and J. M. Muir, Toronto, secretary-treasurer.

Dr. Vlada A. Getting, Massachusetts State health commissioner, was recently named chairman of the New England Interstate Water Pollution Control Commission. Other officers are: Walter J. Shea, chief of the Rhode Island State Division of Sanitary Engineering, secretary; Benjamin L. Barringer, of Connecticut, vice-chairman; and Leo Marceau of Massachusetts, treasurer.

G. G. Greulich, consulting engineer with the Carnegie-Illinois Steel Corp., has been elected president of the Pittsburg Section, American Society of Civil Engineers. Other officers include: C. A. Keelen, vice-president, and directors Michael K. Armentrout, William N. Dambach, Charles M. Wellons, A. E. Allen. Wilfred Bauknight, W. F. Trimble, Jr., Frank Bromilow, F. W. Edwards and D. L. Somerville.

W. L. McFaul, city engineer of Hamilton, Ont., has been elected chairman

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PROCESSING 3,000 LINEAR FEET PER DAY

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This 10½ mile stretch of road, 22 feet wide and processed to a depth of 6 inches, was completed in only 21 working days.

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Depth of treatment — 6 inches, compacted.
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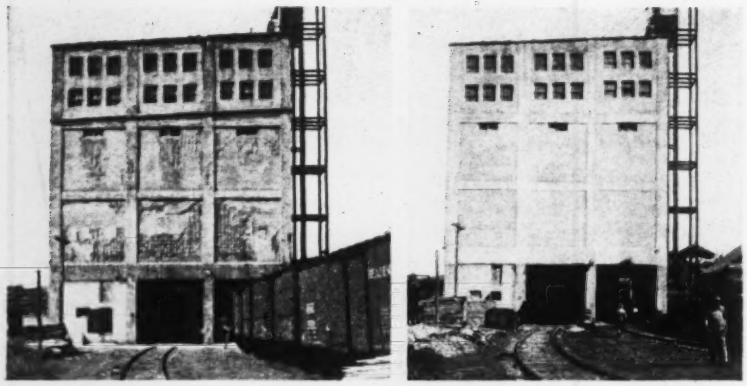

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The disintegrated areas of the walls were chipped and the entire surface washed and sandblasted. Reinforcing mesh was placed over the entire area and 1½" minimum "GUNITE" applied, and brush finished. The roof slab was similarly repaired with "GUNITE," both top and bottom. Sufficient old concrete was chipped away to prevent increasing the dead load of the roof slab.

"GUNITE" is impervious, thus it will not permit the infiltration of salt brine to attack the reinforcement. Its use as armor against sea water and conditions such as above described is very common, and its success remarkable.

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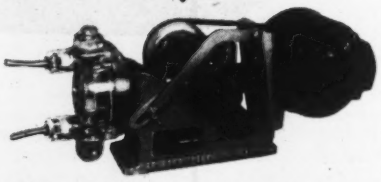

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for Eastern Canada of the American Public Works Association.

J. A. McNeil has been chosen to head the Associated General Contractors, southern California chapter. Thomas Paul, Edward Green and J. A. Thompson were named vice-presidents and A. L. Pozzo, treasurer. New directors are: W. W. Hoagland, Claude A. Fisher, Donald E. Reed and B. W. Laulhere.

R. P. Reece of Winston-Salem has been elected president of the North Carolina Society of Engineers, succeeding A. Paul Lyman of Raleigh. Other officers are: William E. Henry, Jr., of Charlotte, vice-president; and LeRoy Keever of Raleigh, re-elected treasurer.

All officers of the Minnesota AGC have been re-elected as follows: President, J. R. Sweitzer; J. A. Swanson, secretary-treasurer; D. J. M. Leck, vice-president, builders' division; John Dieseth, vice-president, highway division; and George Heller, vice-president, heavy division. Three new directors were elected for 3-year terms—P. M. Dougall, builders' division; D. W. Webster, highway division; and E. J. Cox, heavy division.

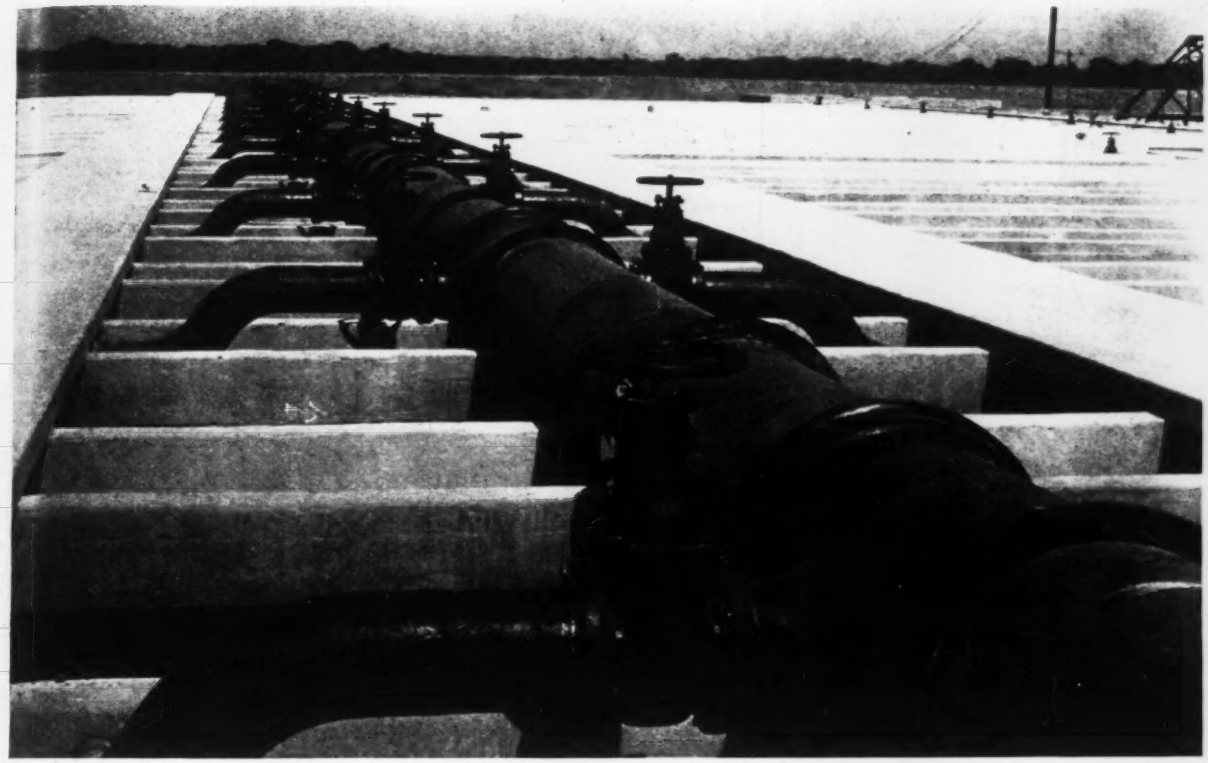
Paul S. Roel, Fargo, has been elected president of the Associated Contractors of North Dakota, succeeding Joseph R. Mackley. Other officers are John E. Larson, Bismarck, first vice-president; Joseph M. Powers, Fargo, second vice-president; Orval Hagen, Minot, re-elected secretary; and Ole Flaten, Minot, re-elected treasurer. E. A. Moline of Jamestown, Iver E. Orheim of Minot, and Oliver A. Stoutland of Fargo, were named directors to succeed A. C. Johnson, Victor Leeby and Ole Flaten.

Herman G. Baity of Chapel Hill has been elected president of the North Carolina Section of the American Society of Civil Engineers. Other officers are: John D. Watson of Greensboro, first vice-president; and B. W. Davis of Raleigh, second vice-president.

The Kansas Engineering Society recently held its 40th annual convention. It now has more than 700 members and is considering affiliation with the National Society of Professional Engineers.

New officers of the Kansas Contractors Association are: E. C. Stewart, president; N. C. Miller, vice-president; C. L. Burt, treasurer, and J. W. Ballard, engineer and secretary.

The Michigan Society of Professional Engineers has elected these officers: Otto H. Hall, president; Prof. H. E. Keeler, 1st vice-president; A. F. Plant,



24" Mono-Cast Centrifugal Pipe, 24" x 8" Tees and 8" Offsets installed as main air line of sewage treatment works.

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STEEL SASH

Architects and Engineers, more and more, specify the use of protective zinc coatings for the *utmost protection* to metal components of all types of exposed structures.

The American Hot Dip Galvanizers Association have established and are pledged to follow the highest standards in Hot-Dip Job Galvanizing. They assure the highest quality of workmanship, the best in materials, and employ the newest and most modern methods.

The collective know-how of the entire membership is available to you through the member whose location can best serve you. For membership roster write the Secretary, American Hot Dip Galvanizers Association, First National Bank Building, Pittsburgh, Pa.

hot-dip GALVANIZING

2d vice-president; W. C. Berryman, secretary; and L. K. Evans, treasurer.

Officers and directors of the Texas Society of Professional Engineers have been elected as follows: Trigg Twichell, chief of the U. S. Geological Survey's surface water division at Austin, president; O. H. Koch of Dallas, first vice-president; Mason G. Lockwood of Houston, second vice-president; T. C. Forrest, Jr., of Dallas, national director; State director, R. H. Knipping of San Antonio, Gibbs Dyer of Dallas, O. V. Adams of Lubbock, M. E. Spry of Odessa, B. B. Cruise of Beaumont, E. E. Rosaire of Houston, H. P. Mathieu of Pampa and Henry Harkelroad of Austin.

Carl E. Green, Portland, has been elected president of the Professional Engineers of Oregon. John T. Hood, Portland, was chosen vice-president; and named to the board of trustees were: William Allen, Portland; W. C. Hill, Salem, and D. B. Ambler, Walport.

Col. Barroll Anderson has been elected president of the San Diego, Calif., chapter of the Society of American Military Engineers. Lt. Col. A. H. Trumbull was named first vice-president; Capt. Paul Brunkow, second vice-president; Marvin Hankins, secretary, and Robert Haines, treasurer.

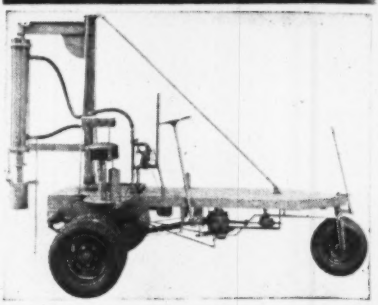
The Nebraska section of the American Society of Civil Engineers has elected Burgess Manchester, Omaha, president for a 2-year term. Rex Edgecomb, Lincoln, was elected senior vice-president and F. B. Schlicter, Omaha, junior vice-president.

New board members of Intermountain branch, Associated General Contractors of America, were recently announced by Allen E. Mecham, general manager. Elected to 2-year terms were: Chester P. Cahoon, Roy Grant, Walter W. Kershaw, Gordon I. Kirby and J. Leonard Love; one year: H. L. Cromar, Albert A. Eck, Ezra C. Knowlton, C. M. Plant and F. H. Pyke.

The Alabama Road Builders Association has elected Clyde O. Mitchell, of Birmingham, president to succeed J. P. Moss. Other officers are: Quinn Flowers, Dothan, vice-president; T. F. Tobart, Birmingham, secretary; W. R. J. Dunn, Jr., Birmingham, treasurer; E. N. Rodgers, Montgomery, engineer-manager. Retiring president Moss, M. R. Thomason and William B. Goodwyn, Montgomery, were elected directors.

The Spokane, Wash., chapter of the Washington Society of Professional Engineers has elected Howard Stingle of the Washington Water Power Co. as

BREAK PAVEMENT the low cost way!



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cuts concrete and tamps back fill . . . will break inside floor and vertical walls. Cost of breaking and tamping is one-sixth to one-tenth other methods.

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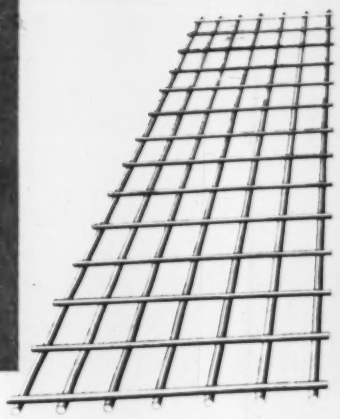

TIME

Clinton Welded Wire Fabric comes in sheets or rolls cut to your specification. It's easy to store, handle and use.

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There are no ties or clips to come undone or to interfere with the smooth flow of concrete around intersections.

EXPENSE

The speed with which Clinton Welded Wire Fabric can be handled reduces placing costs while its high tensile strength is an assurance of long, dependable service and freedom from maintenance costs.

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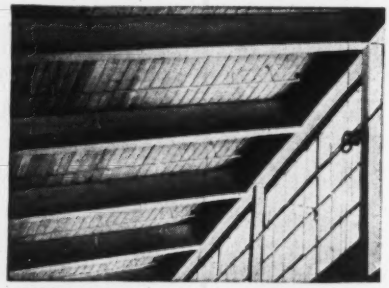
High Humidity IN BUILDINGS?

Prevent decay with "CZC"-treated wood

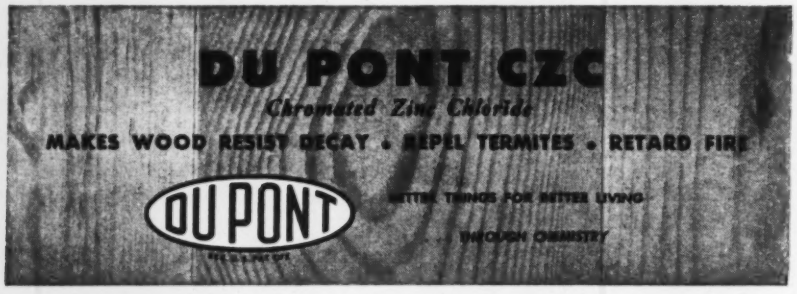
Moisture-laden air provides ideal conditions for the growth of decay fungi, but these fungi can't flourish in wood that's been treated with "CZC." Du Pont Chromated Zinc Chloride protects wood—gives it years of additional life.

Wood that has been pressure-impregnated with "CZC" has many other advantages, too. It resists termites, retards fire, is clean, paintable, and easy to handle.

You'll find that maintenance costs are cut to a minimum—costly repairs and replacements are eliminated—wherever "CZC"-treated wood is used. E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.



"CZC"-treated wood prevents decay in textile mill roofs where humidity is high.


DU PONT CZC
Chromated Zinc Chloride
MAKES WOOD RESIST DECAY • REPEL TERMITES • RETARD FIRE
DU PONT
BETTER THINGS FOR BETTER LIVING
THROUGH CHEMISTRY

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Write for literature showing UNIT'S many modern and exclusive features.
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its new president. Other officers are R. E. Tobin, managing engineer of the Portland Cement Association, vice-president; William Connolly, consulting engineer, secretary, and J. G. McGivern, who is dean of engineering at Gonzaga University and retiring chapter president, to serve as the state representative.

Walter Scheilke, of Birmingham, contracting engineer for the Virginia Bridge Co., has been elected president of the Alabama Section, American Society of Civil Engineers.

The North Carolina State Highway Employees Association, formed recently to promote the well being of highway employees, has been incorporated. Among the incorporators are these engineers: Earl Crump of Wilson, T. F. Royall of Wadesboro, and Otis Banks of Raleigh.

George L. Macpherson of Sarnia, Ont., has been elected president of the Association of Professional Engineers of Ontario.

George R. Boddie, Gulfport, has been named president-elect of the Mississippi Society of Professional Engineers. W. E. Johnson, Jackson, retiring president-elect, was installed as president. R. H. Young, Jackson, was re-elected secretary-treasurer.

These officers of the Connecticut Chapter Associated General Contractors of America have been elected: President, Walter A. Hubbell, president of the S. W. Hubbell Building Co., Bridgeport; vice-president, Charles L. Gellatly, head of the Gellatly Construction Co., Bridgeport; treasurer, Edwin C. Wheeler, Bridgeport contractor; and secretary, Henry B. Maury.

Charles W. Nicol, of Charles W. Nicol & Associates, has been re-elected president of the Chicago Building Congress. William Holabird, of Holabird & Root, was elected first vice-president. Four other vice-presidents elected are A. C. Cronkrite, Universal Atlas Cement Co.; Johua D'Esposito, consulting engineer; Elmer C. Jensen, Mundie, Jensen & McClurg, engineer-architects, and E. K. Collison, George A. Fuller Co., building contractor. Paul D. Angell, of Paul D. Angell & Co., continues as secretary.

Orland C. Mayer of Boise, manager of commercial and industrial sales for the Idaho Power Co., has taken office as president of the Idaho Society of Engineers. Vice-president is Allen S. Janssen, dean of the college of engineering at the University of Idaho, Moscow.

ACCURACY *that rolls out smooth as glass!*

- **Hydraulic Controls** — for easy handling
- **Continuous Course Correction**— corrects irregularities with successive courses
- **Powerful Six Cylinder Engine** — power to handle the heaviest truck
- **Four Wheel Drive**
- **Cutter Bar**—overlaps and compacts joint—"crowds" and compacts materials
- **Power Cut-Off** — permits carrying load over intersections and eliminates tag-end run-outs
- **End Gates** — permit feeding material out to sides with cutter bar extension
- **Screed Heater** — assures better handling of material
- **Crowning Adjustment** — for any crown or bank
- **Either Rear Roller** — can be disengaged for quick turning
- **Hopper** — big . . . adjustable . . . for narrow pavements
- **Sturdy, Heavy Construction**—that stands the strain of work without constant rebuilding
- **Adnun Carryall**—easily attached . . . makes moving up on jobs easy

● Look at that course behind the Adnun. That black top will roll out as smooth as a billiard table. Continuous Course Correction, the remarkable feature of the Adnun that corrects irregularities with each successive course, means smoother pavements. It means less preparation of subgrade and old pavements when recapping. It means true automatic leveling.

Add to this the important fact that the Adnun is built for the punishment that comes with handling heavy trucks. Contractors say Adnuns don't have to be rebuilt as often. Check the other features that Adnun brings you and plan to have one on your next black top contract.

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BLACK TOP PAVER
MULTIFOOTE CONCRETE PAVERS
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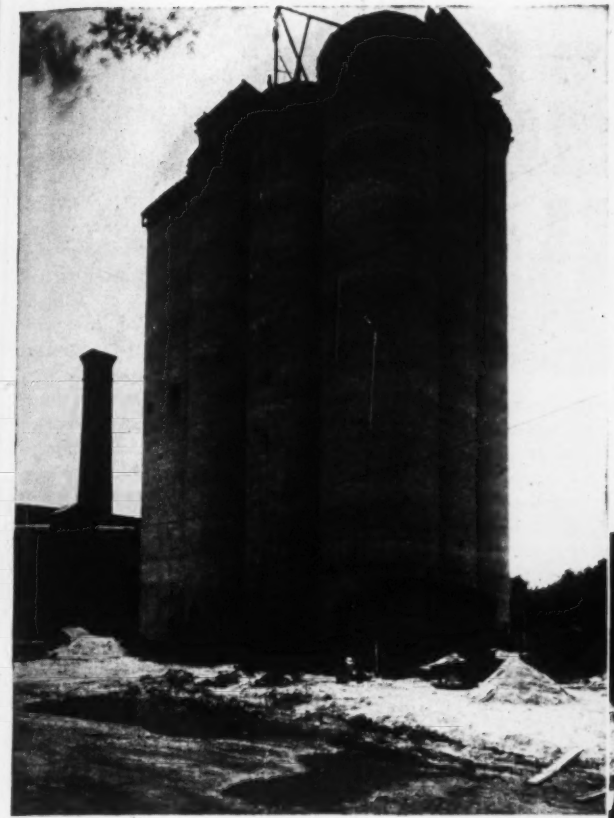
UNITED STATES STEEL

Manufacturers' Activities

Current developments among manufacturers relating to expansion of services, shifts in personnel, and other changes, include the following:

Home Office Changes—New officers recently elected by the ROCKWELL MFG. Co., Pittsburgh, Pa., are: J. E. Ashman, vice-president and controller; E. W. Meyers, secretary; M. J. Carl, treasurer; Paul A. Wick and I. C. Rowe, assistant secretaries . . . J. H. Coover has been promoted to manager of production and research by D-A LUBRICANT CO. INC., Indianapolis, Ind. . . . J. Donald Rollins has been promoted to chief engineer of the Gary Works, CARNEGIE-ILLINOIS STEEL CORP. . . . Louis Allis, Jr., has been made vice-president in charge of sales for the LOUIS ALLIS CO., Milwaukee, Wis.; Frank O. Kovich, vice-president in charge of manufacturing; and T. R. Wieseman, vice-president in charge of engineering . . . Harvey W. Rockwell is chief engineer of LA PLANT-CHOATE MFG. CO., Cedar Rapids, Ia.

Sales Staff Changes—O. B. Wilson is industrial manager for the eastern sales region for the Brown Instrument division of MINNEAPOLIS-HONEYWELL REGULATOR CO. . . . E. S. Banghart is manager of the N. Y. sales district of the PENNSYLVANIA TRANSFORMER CO. Pittsburgh, Pa. . . . An office at 37 Wall St., New York has been opened to handle sales of PEERLESS PUMPS, with R. C. Engemoen as manager. . . . Emmart La Crosse, Jr., is district sales manager of a new Louisville, Ky., sales office of LINK-BELT CO. . . . Baxter Pearson and W. W. Hayes have joined the staff of the new sales office of MONSANTO CHEMICAL CO. at 421 Southwest Sixth Ave., Portland, Ore. . . . C. M. Binney has been made assistant district manager of the New York sales district of the ALLEGHENY LUDLUM STEEL CORP. . . . Murray D. Shaffer has been appointed director of sales and research consultant for the BUFFALO-SPRINGFIELD ROLLER CO. of Springfield, Ohio . . . Dale D. Spoor is now sales promotion manager of AIR REDUCTION SALES CO. . . . John E. Heuser is now assistant sales manager of the LE ROI CO., Milwaukee, Wis. . . . The BLACK & DECKER MFG. CO., Towson, Md., has made G. M. Buchanan manager of a new branch at Charlotte, N. C. . . . A. E. Duke, district manager, now supervises all West Coast activities of the TWIN DISC CLUTCH CO. of Racine, Wis.



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Engineered to do your job, fast, safely and economically . . .

. . . that is the story behind every Clyde gasoline hoist.

The illustrations show one of the new, low cost 15 H.P. Frame 3 hoists, handling materials on the construction of a 125 foot grain storage silo at Owosso, Michigan.

Its ruggedness of construction — yet light weight are features that make it especially desirable to the contractor who wants portability as well as dependability.

Simplicity of design means better performance at all times . . . no frequent or delicate adjustments required to maintain full hoist efficiency.

Why not consider the advantages of a Clyde Frame 3 hoist on your next job. Write for complete information—just mention Catalog No. 7622.

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GASOLINE HOISTS	ELECTRIC HOISTS
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CLYDE IRON WORKS, Inc.
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Subsidiary of Barium Steel Corp.

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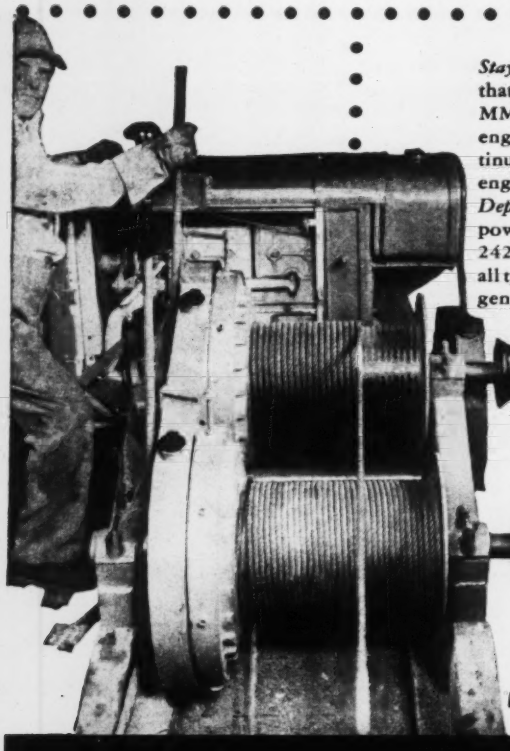
STAYING POWER



Staying Power and *Service* are terms that have long been identified with MM industrial power units and engines . . . For many types of continuous service installations MM engines have achieved records in *Dependability* and *Economy* . . . 7 power units ranging from 20 to 242 h.p. furnish ideal power for all types of crushers, hoists, pumps, generators and many more uses.

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With Dust Proof Ball Bearing Spindle
Transits
Levels
Builders' Levels
Level Rods with Engraved Plastic Face

Manufactured by

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Dealer appointments — HARDINGE CO., INC., York, Pa., has appointed Fred Gibbs Engineering Sales Corp. agent for its products in the New England states . . . J. H. Tiller, Jr., is district representative on motor grinders and rollers in the south central area for the GALION IRON WORKS & MFG. CO., Galion, Ohio . . . Ferguson Supply Alberta, Ltd. of Calgary, Alta., has been appointed a distributor for EUCLID ROAD MACHINERY CO. of Cleveland, Ohio . . . The Henry P. Thompson Co., 416 Schmidt Bldg., Cincinnati, Ohio, is now sales and engineering representative of COCHRANE CORP., Philadelphia, Pa. . . . Harold A. Jope, Wethersfield, Conn., is sales representative for the western half of Connecticut for the HENDRICK MFG. CO., Carbondale, Pa.

Personalities—H. H. Scharff, Jr., has been appointed factory representative of the CLYDE IRON WORKS, INC. in the mid-west district at Chicago, Ill. . . . Carl H. Bauer has been made assistant to the president of THE CELOTEX CORP., Chicago, Ill. . . . Raymond B. Crean has been elected assistant vice-president, production, of the BALDWIN LOCOMOTIVE WORKS . . . CHARLES G. SCHMIDT of the OHIO MACHINERY CO., Cleveland, Ohio, has been appointed manager of that company's Columbus office . . . W. H. Holbert has been appointed manager of the Three Rivers, Mich., plant of FAIRBANKS, MORSE & CO., Chicago . . . Hans Bohnslav has joined ENGINEERING CONTROLS, INC., Los Angeles and New York as vice president in charge of engineering.

Miscellany — All Zanesville, Ohio, operations of The TIMKEN ROLLER BEARING CO. are being consolidated in 50,000 sq. ft. of manufacturing space at 2,300 Linden Ave. . . . CATERPILLAR TRACTOR CO., Peoria, Ill., has established a parts depot at 1,127 Chattahoochee Ave., N. W., Atlanta, Ga., and a similar unit will be opened in the spring at Shreveport, La. . . . "It's Your Move" is the title of a 16 mm. sound film released by the THEW SHOVEL CO., Cleveland, Ohio . . . JOSEPH T. RYERSON & SON, INC., has built a new steel service plant on 65th St. near the Oakland, Calif., end of the Bay bridge . . . MARMON-HERRINGTON CO., INC., Indianapolis, Ind., is now in production on all-wheel-drive conversion for the new FORD models . . . FLEXIBLE TUBING CORP., has entered into the flexible tubing field at Branford, Conn. . . . PIONEER ENGINEERING WORKS, Minneapolis, Minn., has received a certificate of appreciation for its contribution to the training of Latin American engineers.